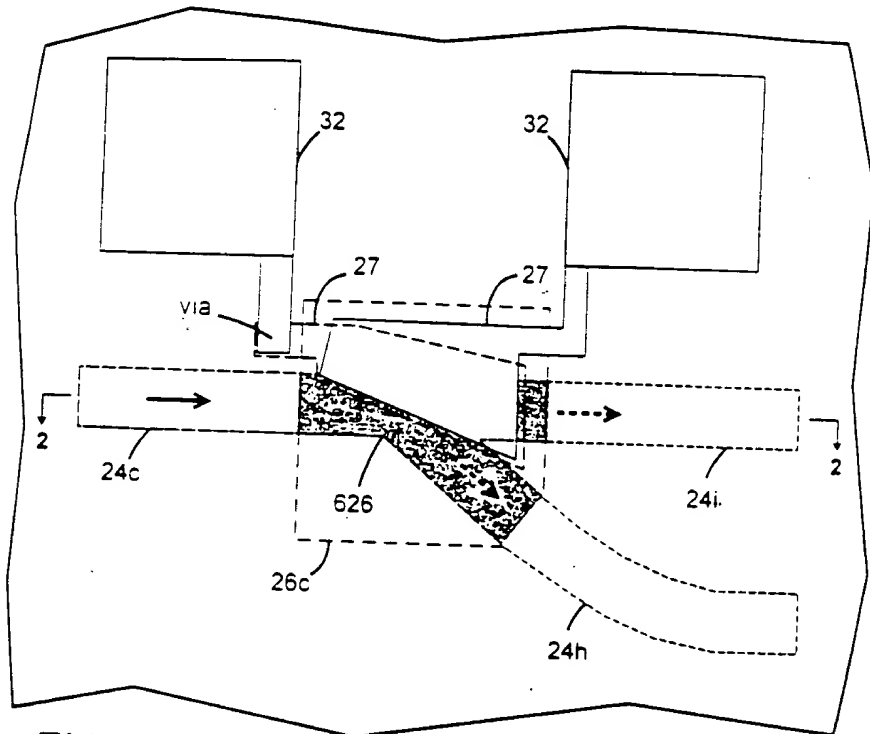


**FIG.\_2**



**FIG. 3**

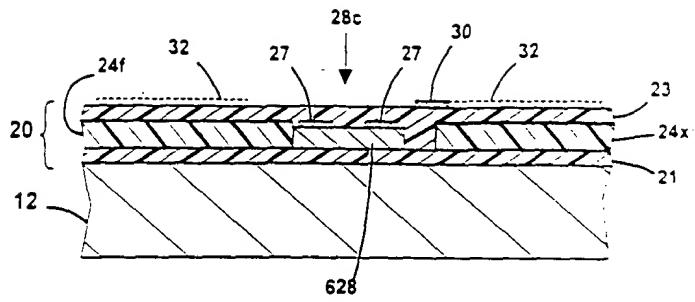


FIG.\_4-1

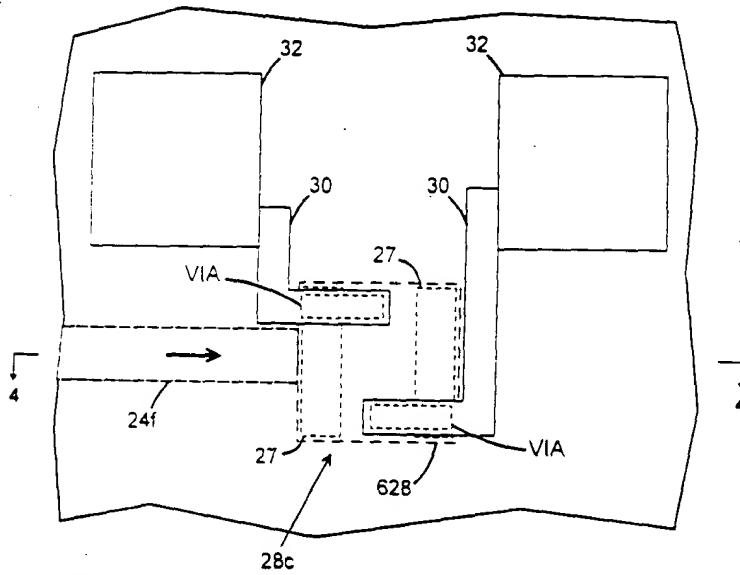


FIG.\_5-1

28c'

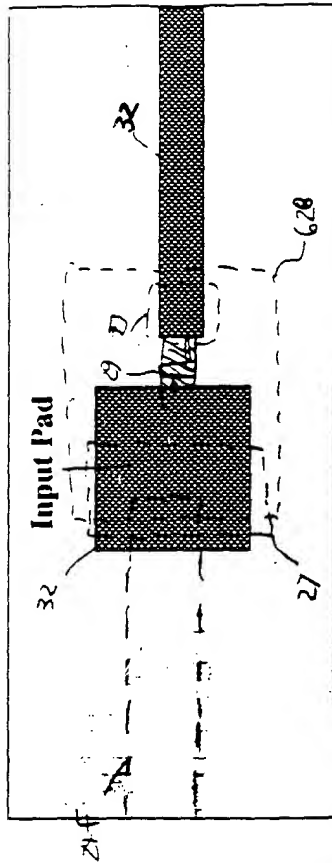


FIG. 5-2

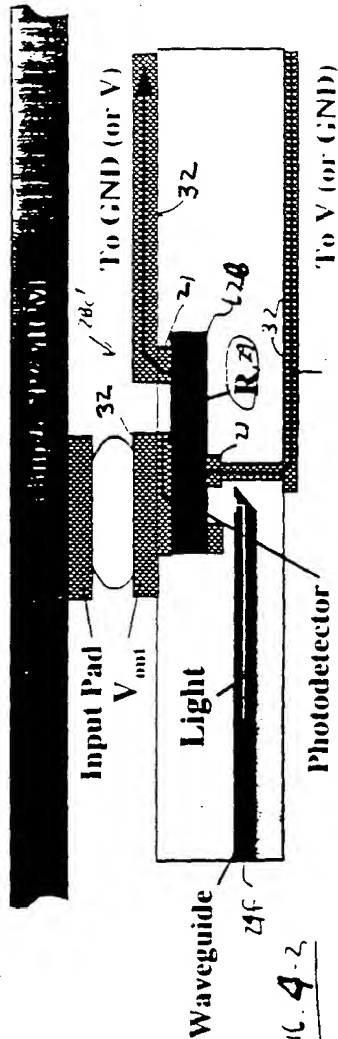


FIG. 4-2

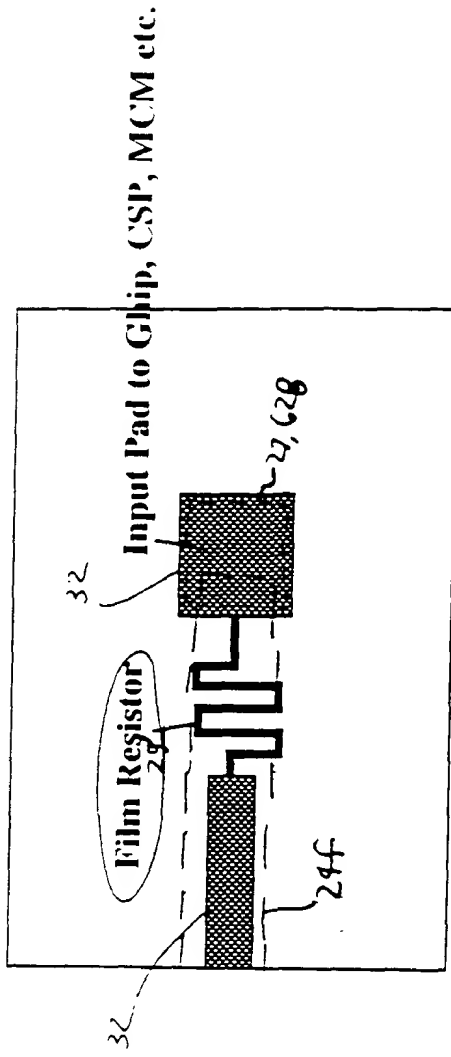


Fig. 5-3

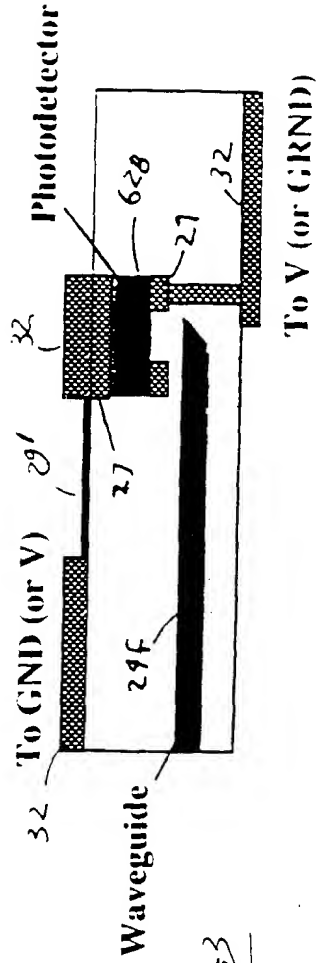


Fig. 4-3

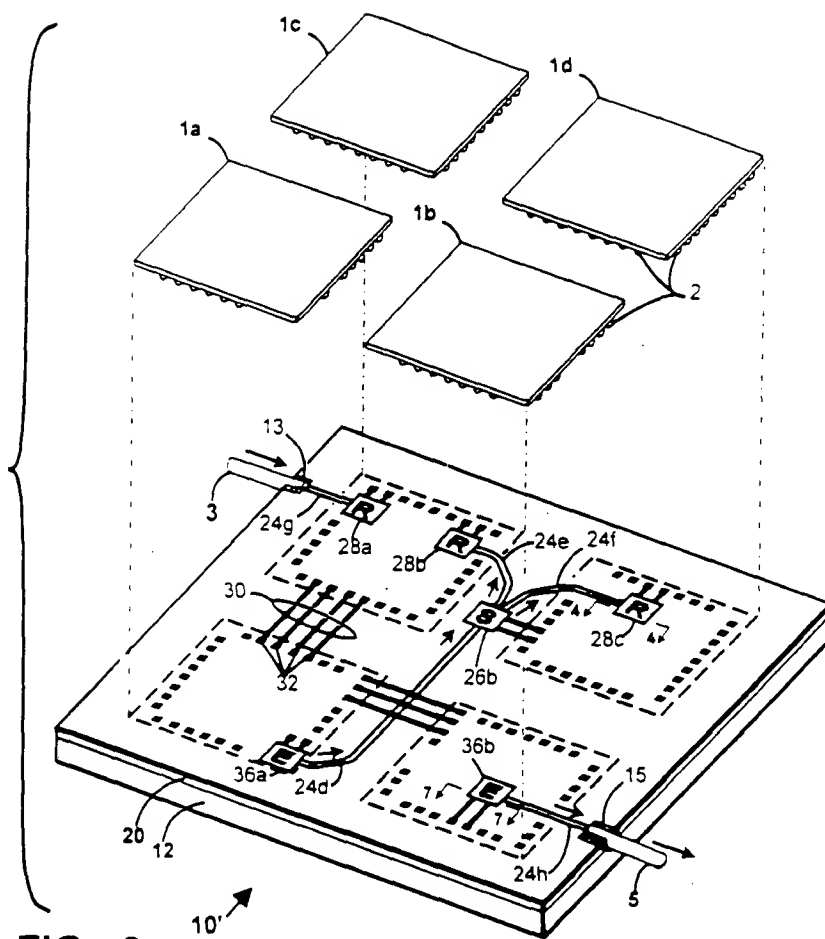
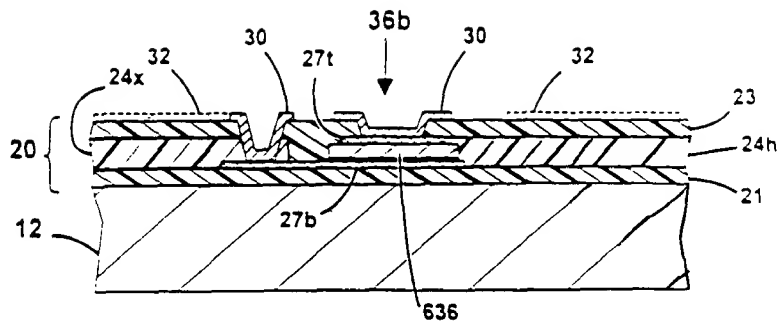
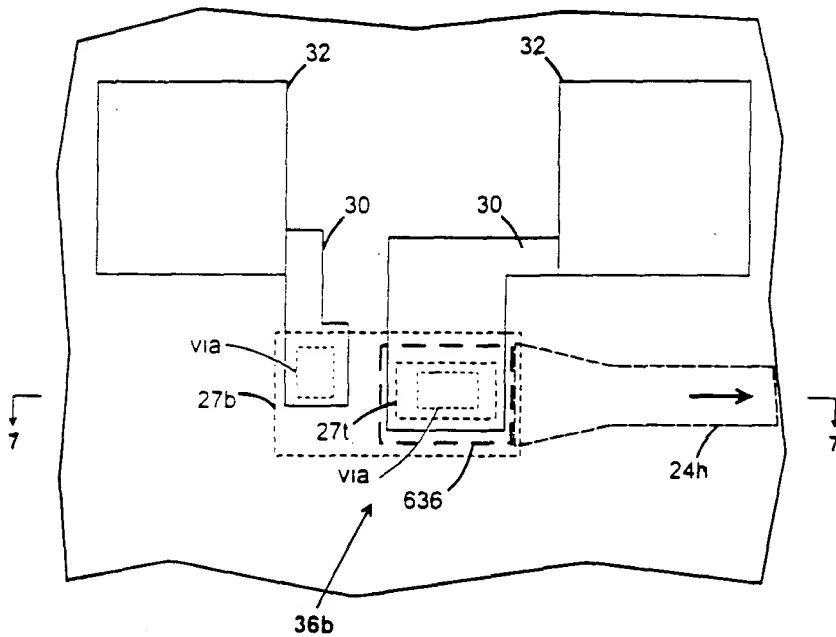


FIG.\_6



**FIG.\_7**



**FIG. 8**

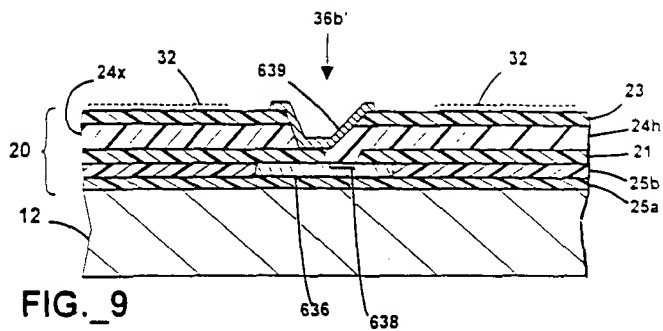


FIG.\_9

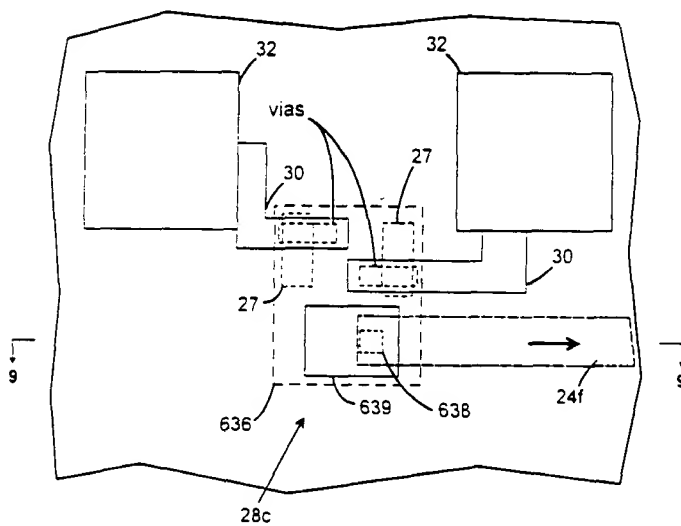


FIG.\_10



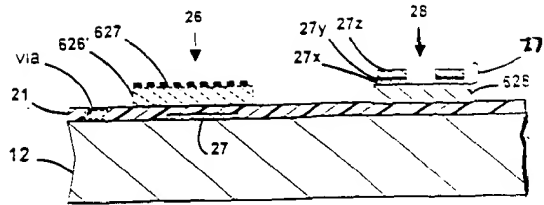


FIG. 11

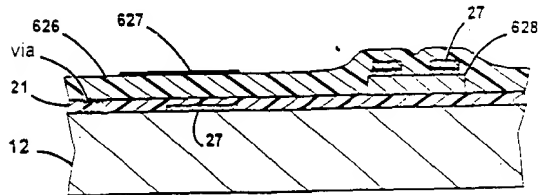


FIG. 12

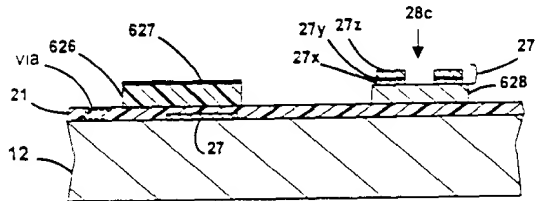


FIG. 13

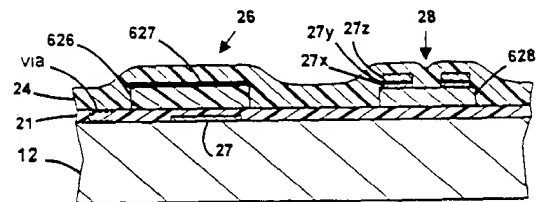


FIG. 14

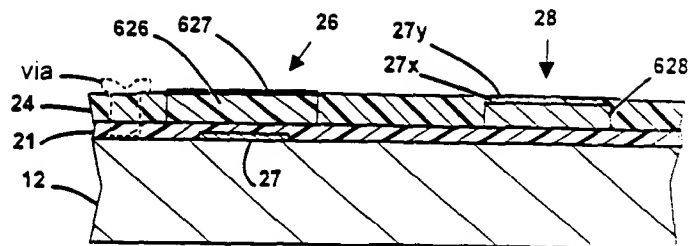


FIG.\_15

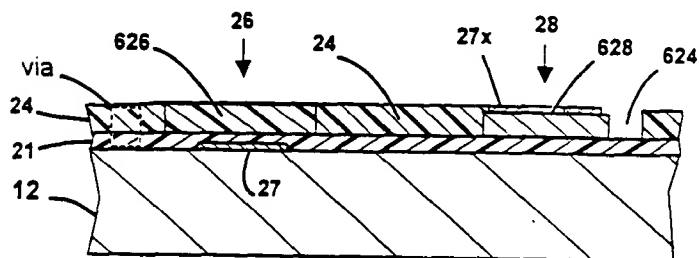


FIG.\_16

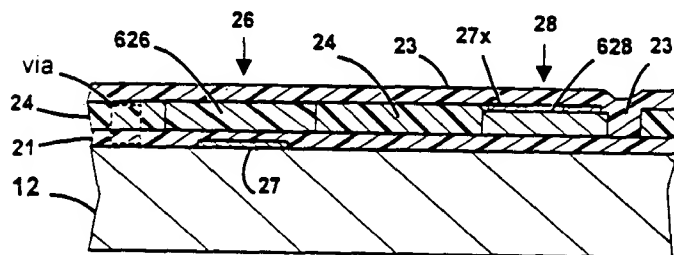


FIG.\_17

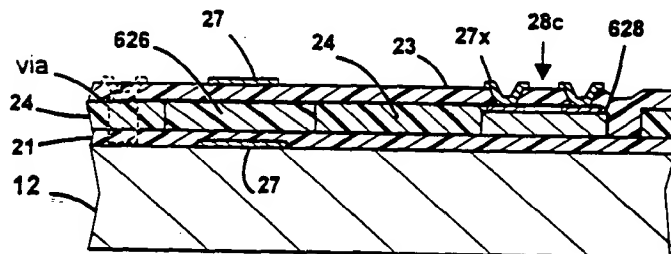


FIG.\_18

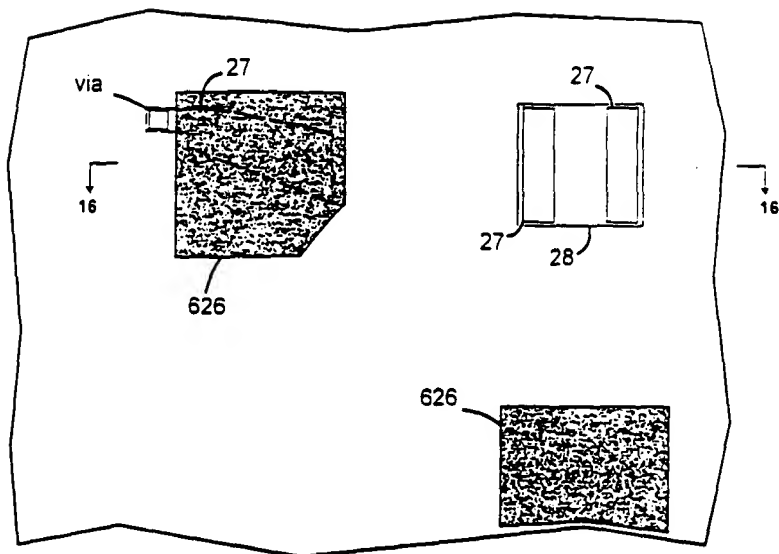


FIG.\_19

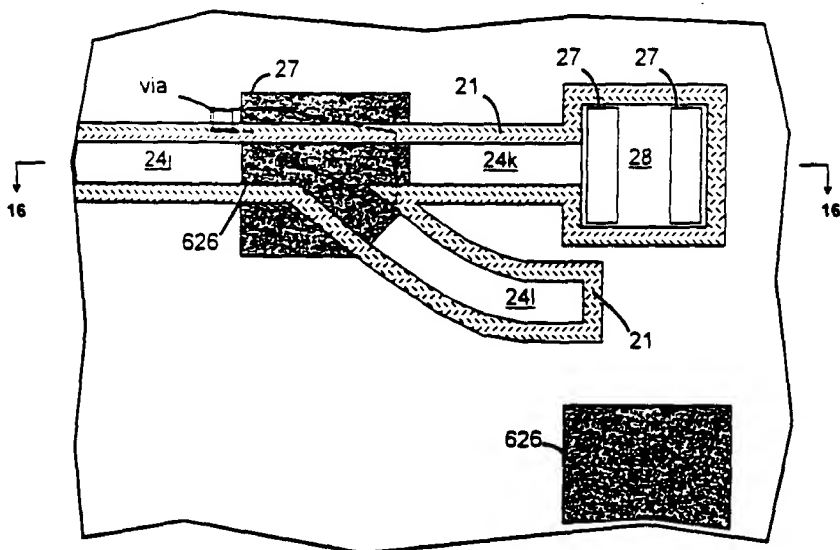
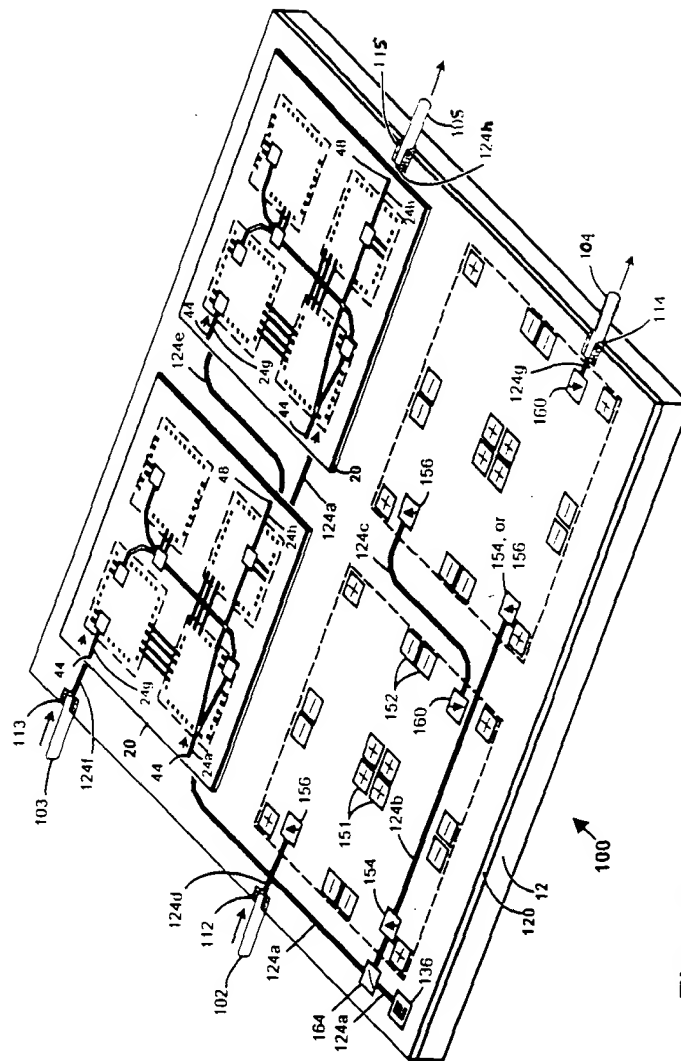


FIG.\_20



**FIG. 21**

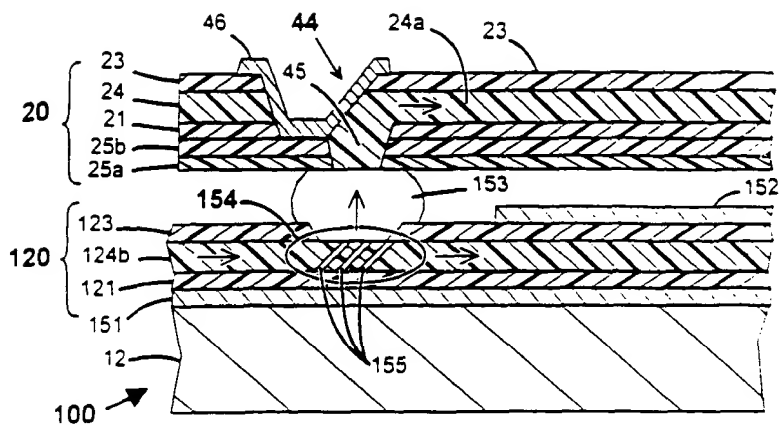


FIG.\_22

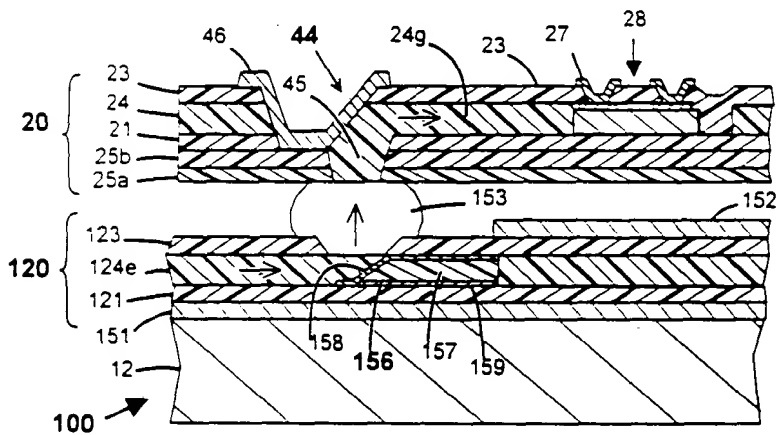


FIG.\_23

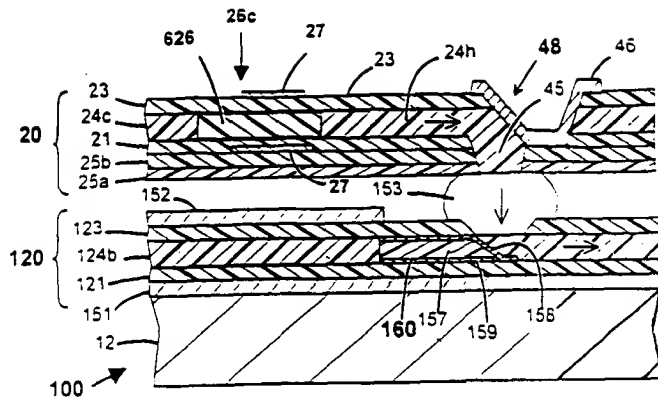


FIG. 24

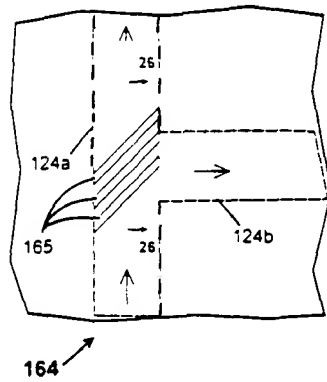


FIG. 25

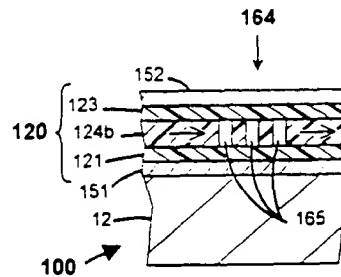


FIG. 26

FIG.\_27

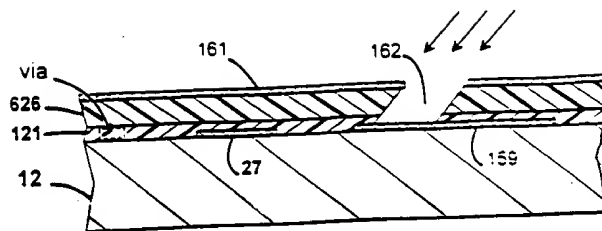


FIG.\_28

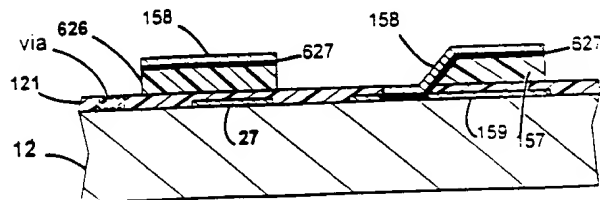


FIG.\_29

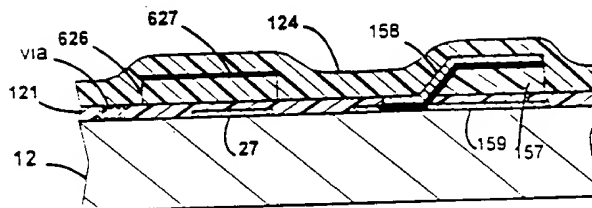
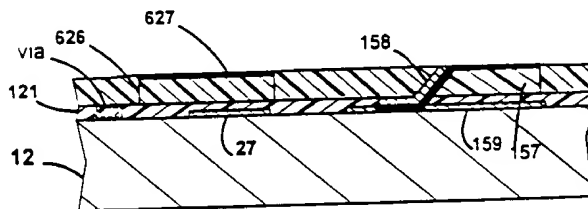
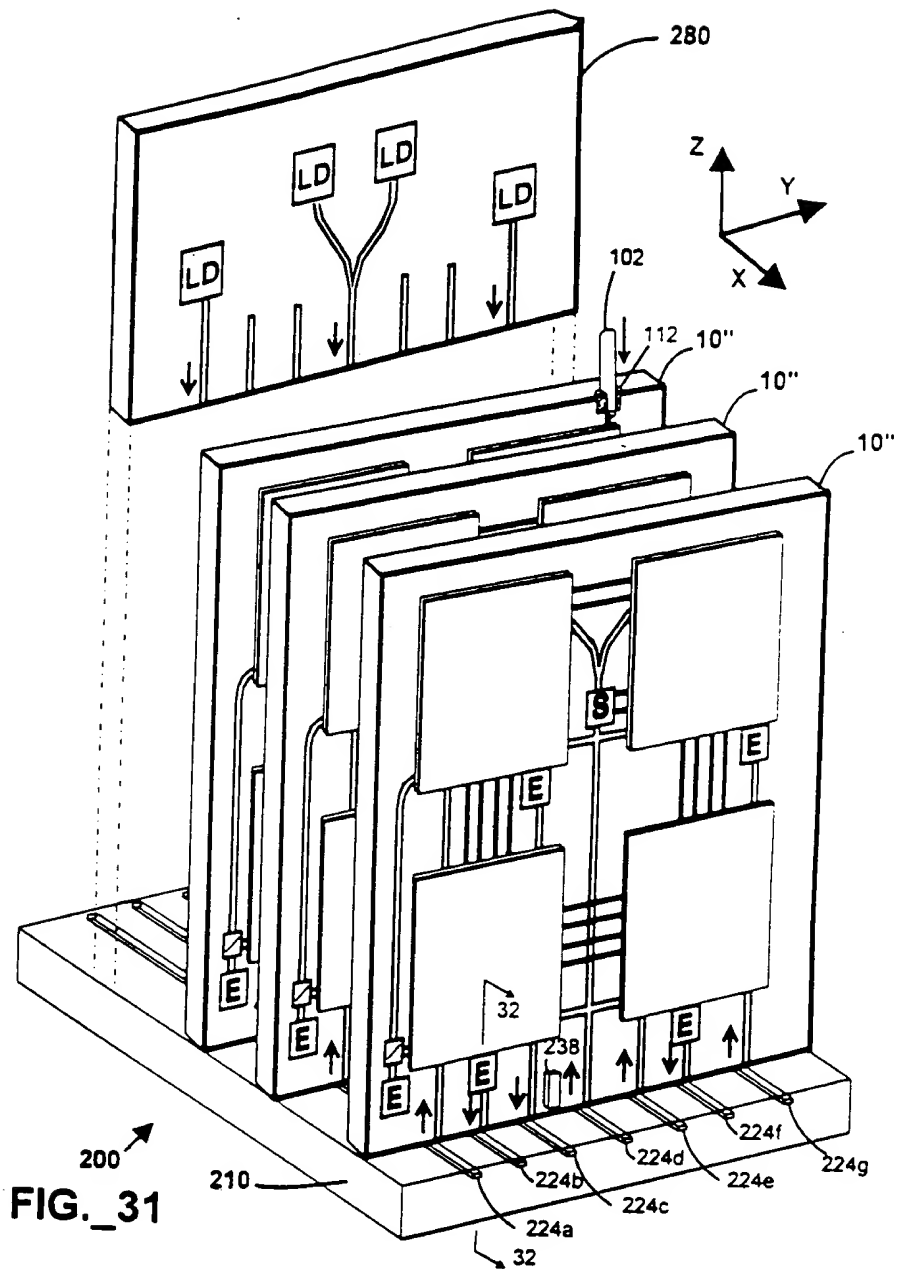


FIG.\_30



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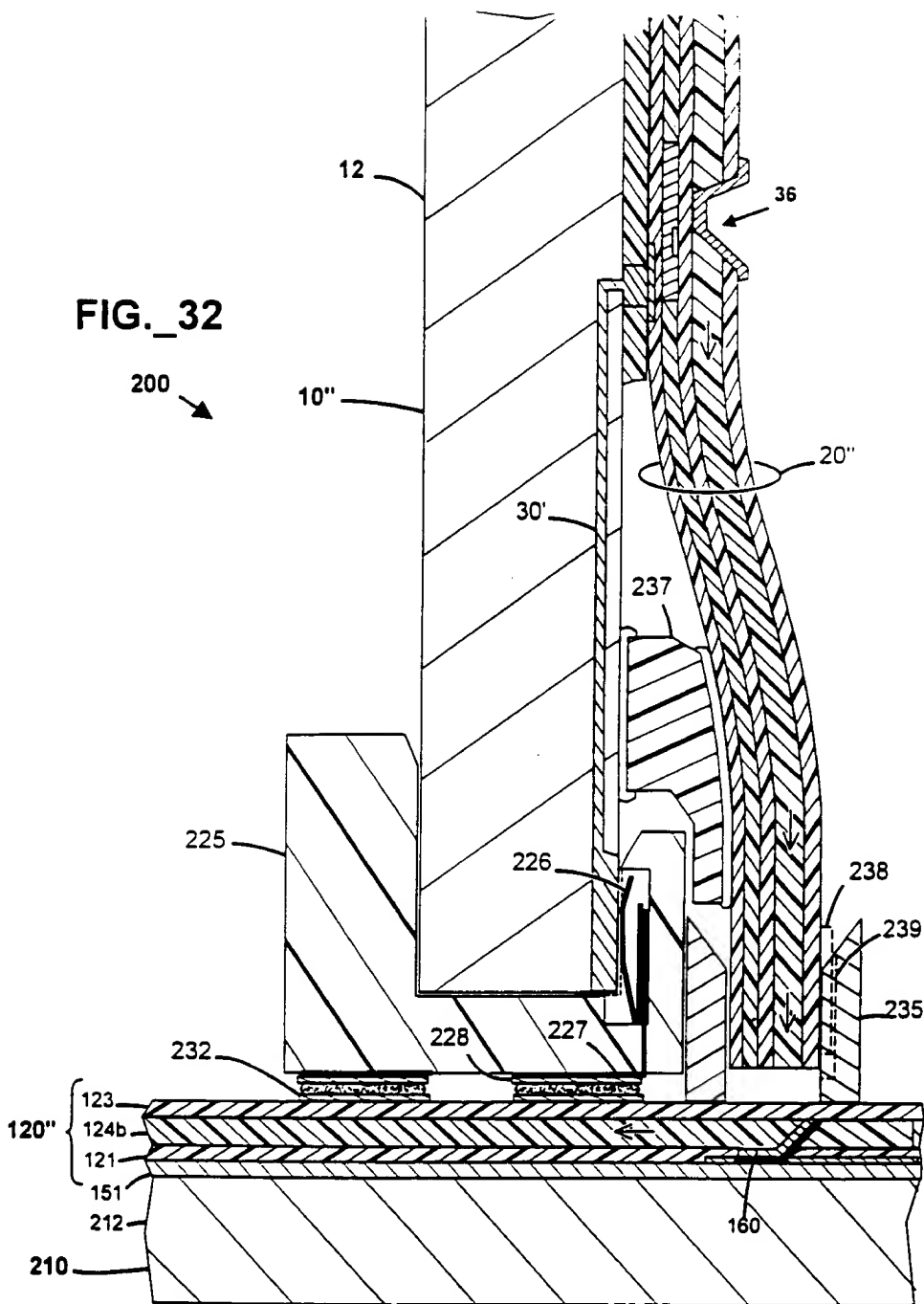
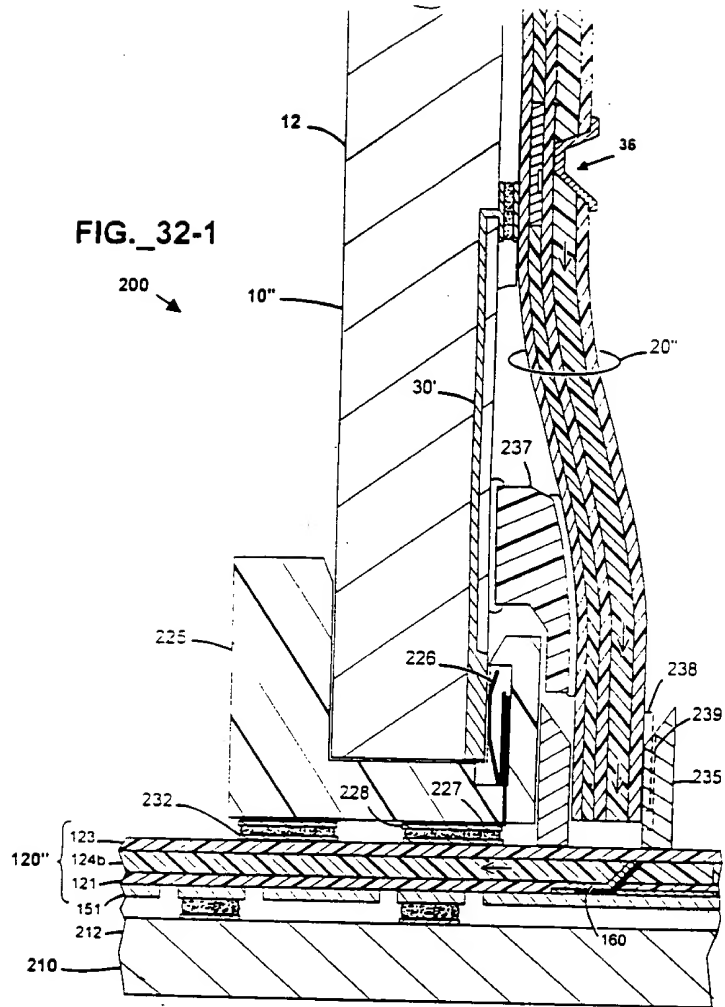
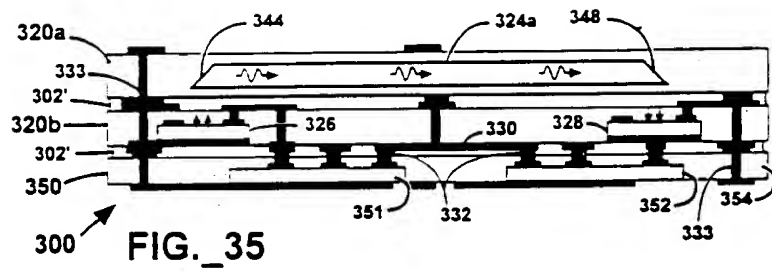
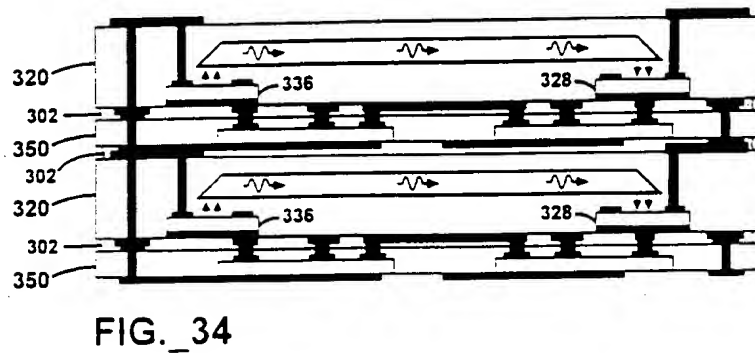
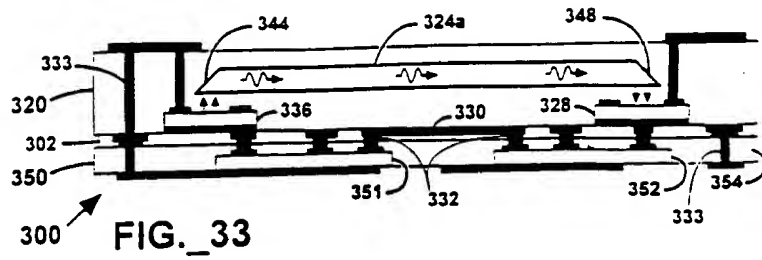


FIG. 32-1





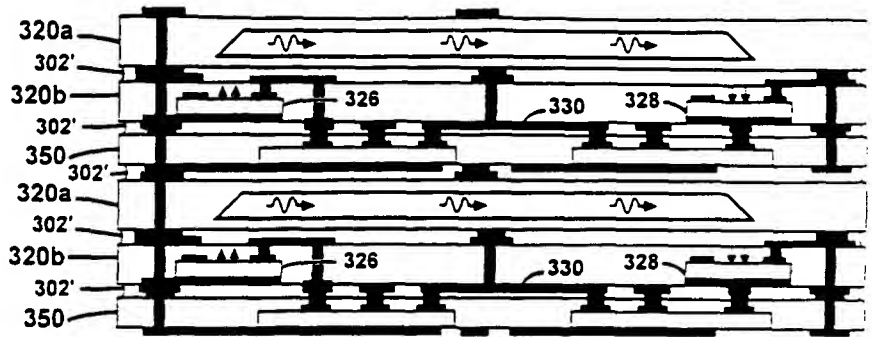


FIG. 36

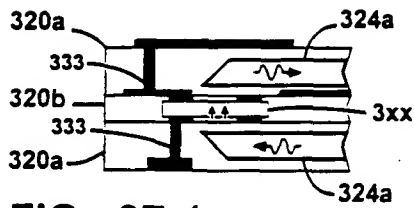


FIG. 37-1

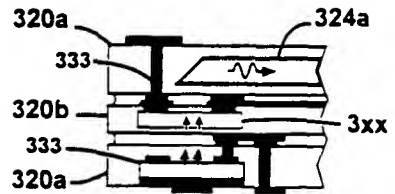


FIG. 37-2

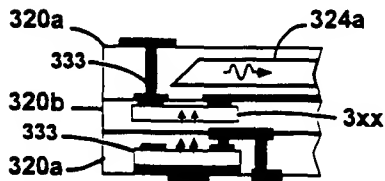


FIG. 37-3

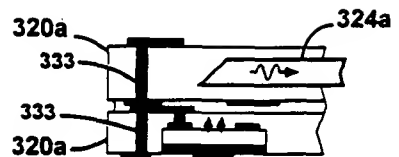


FIG. 37-4

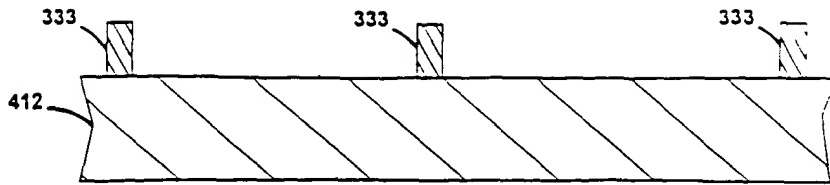


FIG.\_38

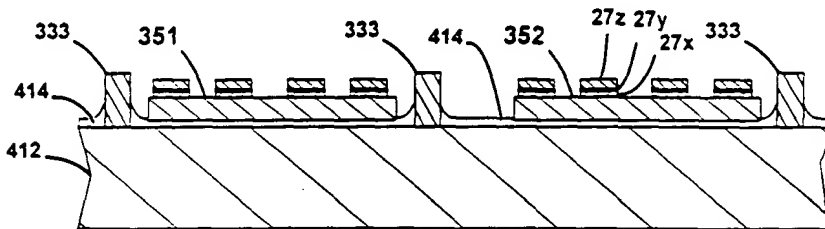


FIG.\_39

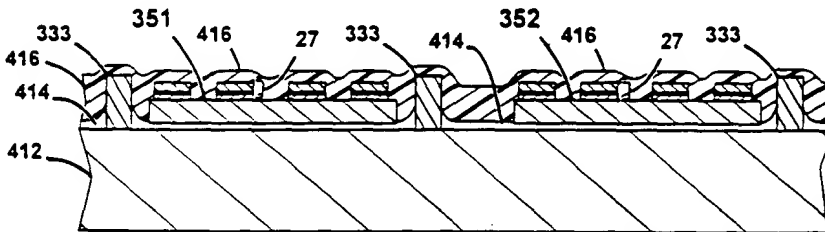


FIG.\_40

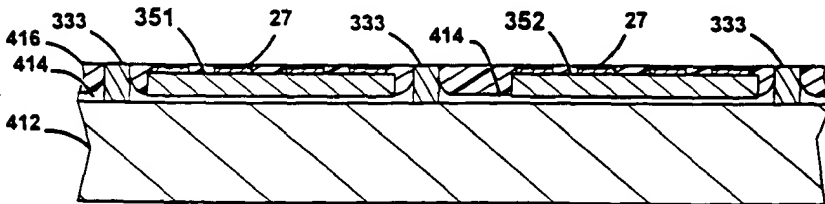
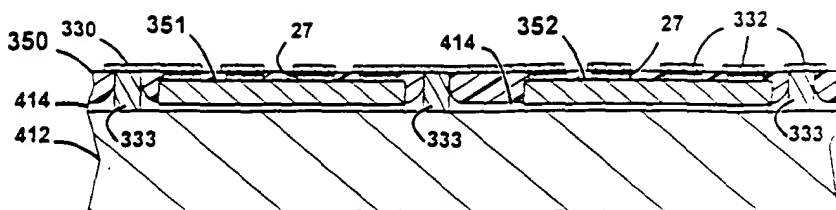
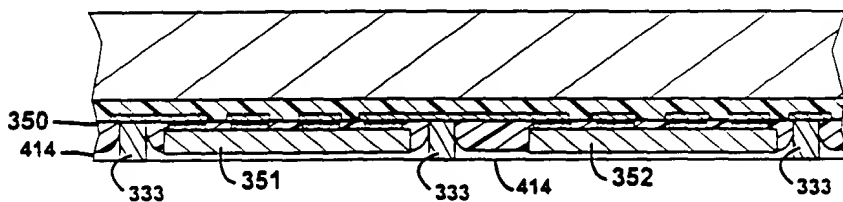


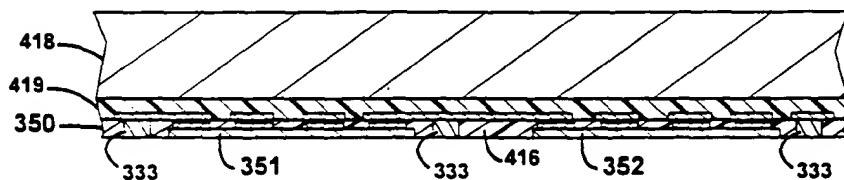
FIG.\_41



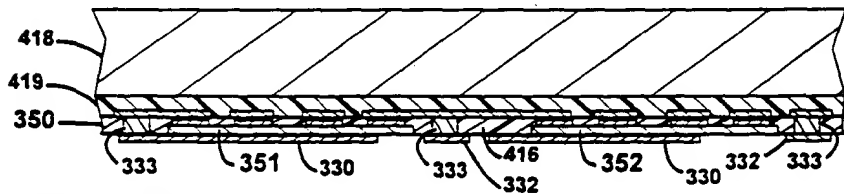
**FIG. 42**



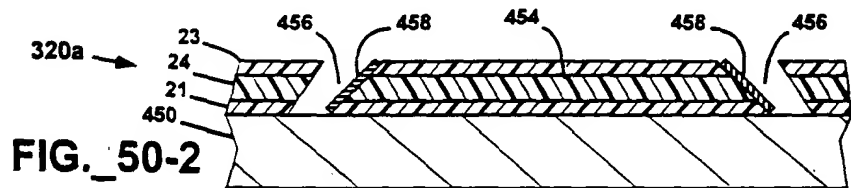
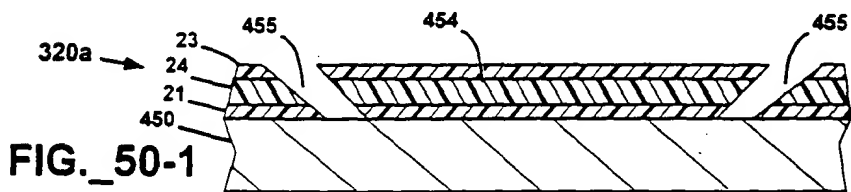
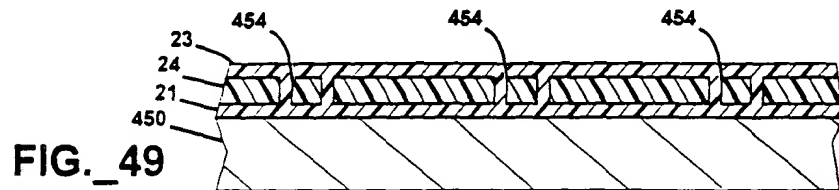
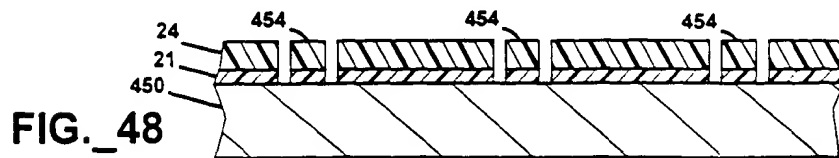
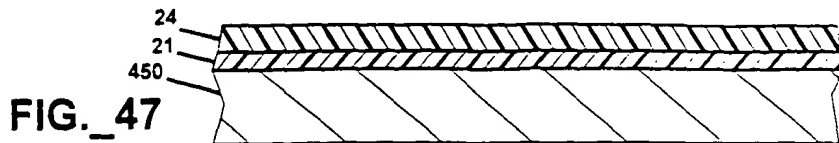
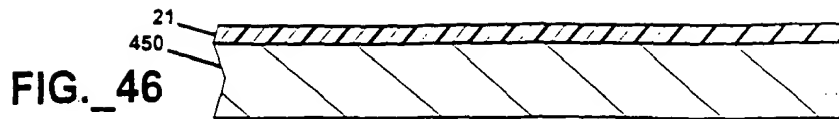
**FIG. 43**

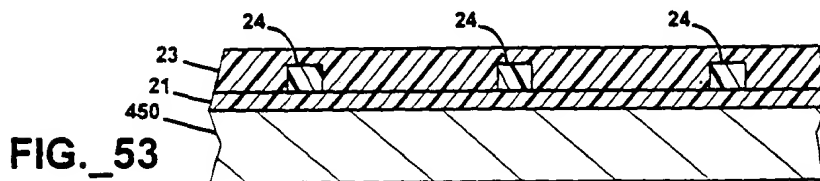
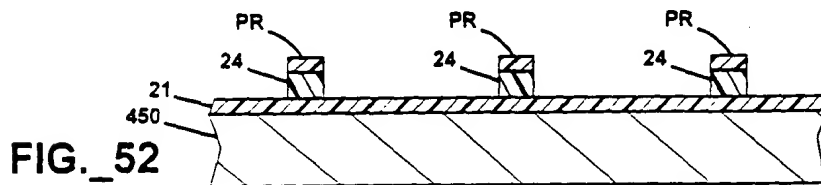
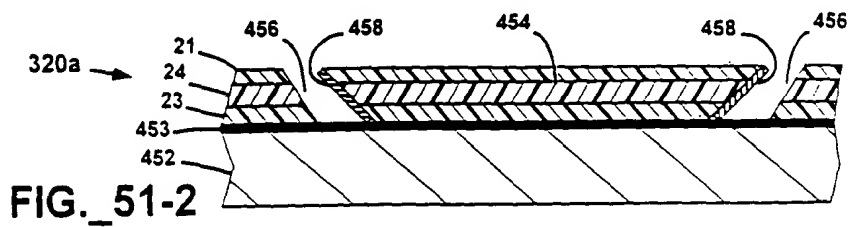
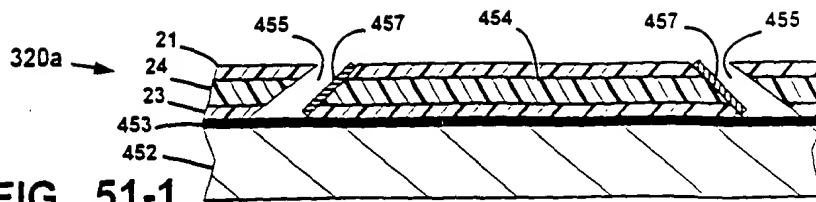


**FIG. 44**

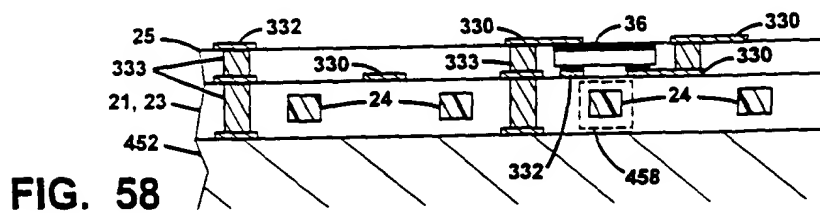
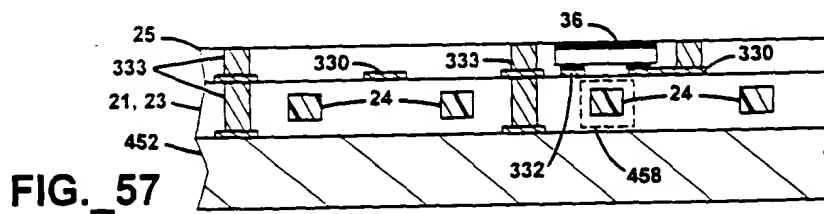
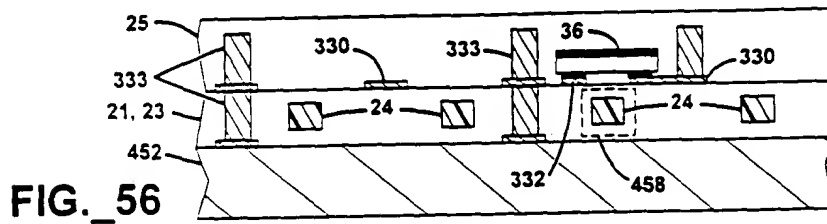
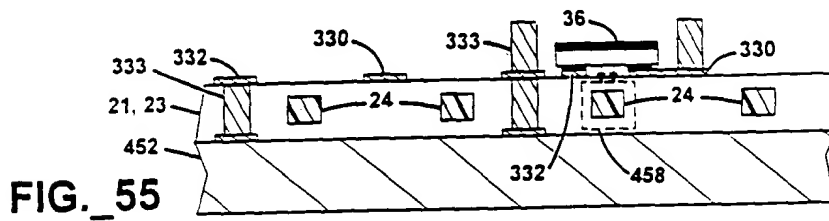
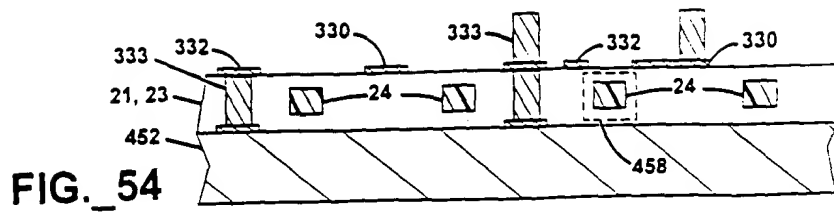


**FIG. 45**









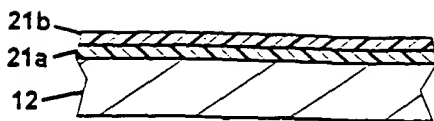


FIG. 59

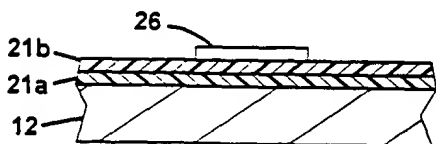


FIG. 60

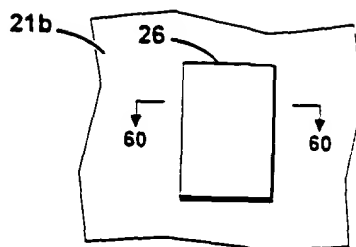


FIG. 61

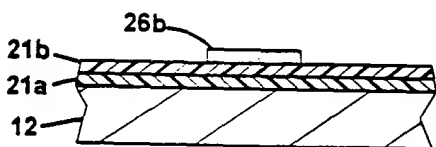


FIG. 62

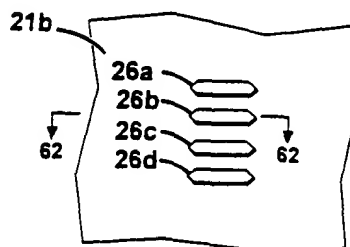


FIG. 63

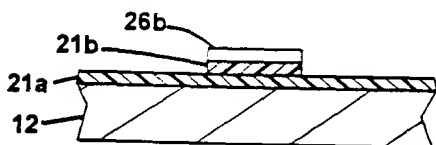


FIG. 64

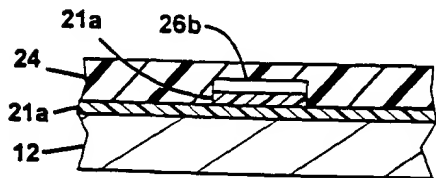


FIG. 65

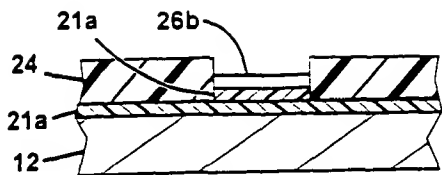


FIG. 66

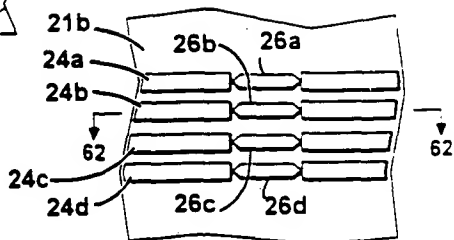


FIG. 67

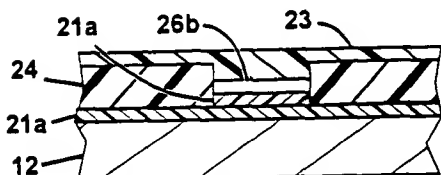


FIG. 68

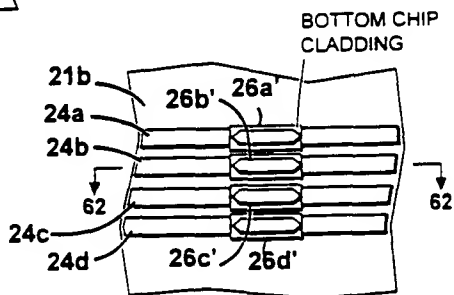


FIG. 67-2

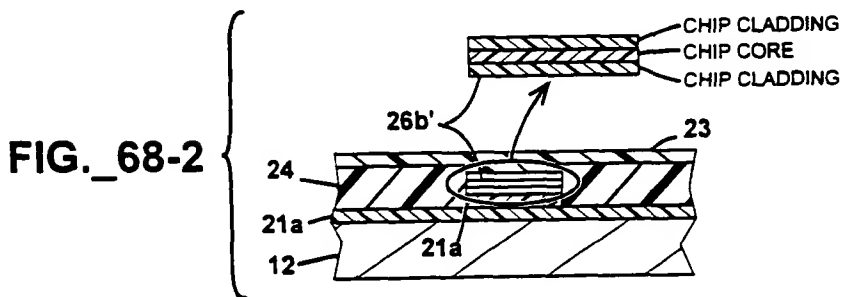


FIG. 68-2

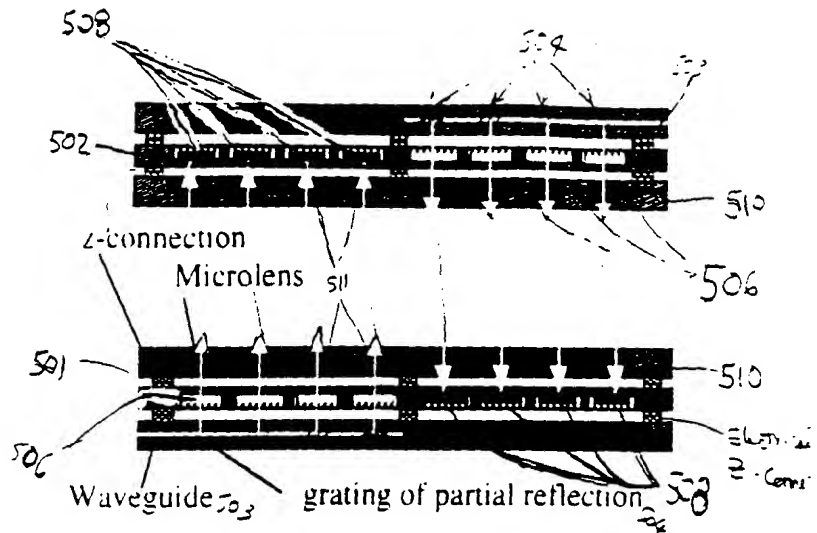


FIG. 69

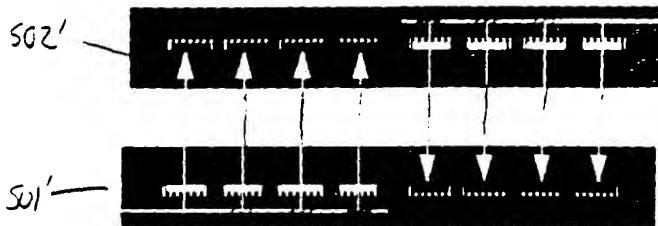


FIG. 70

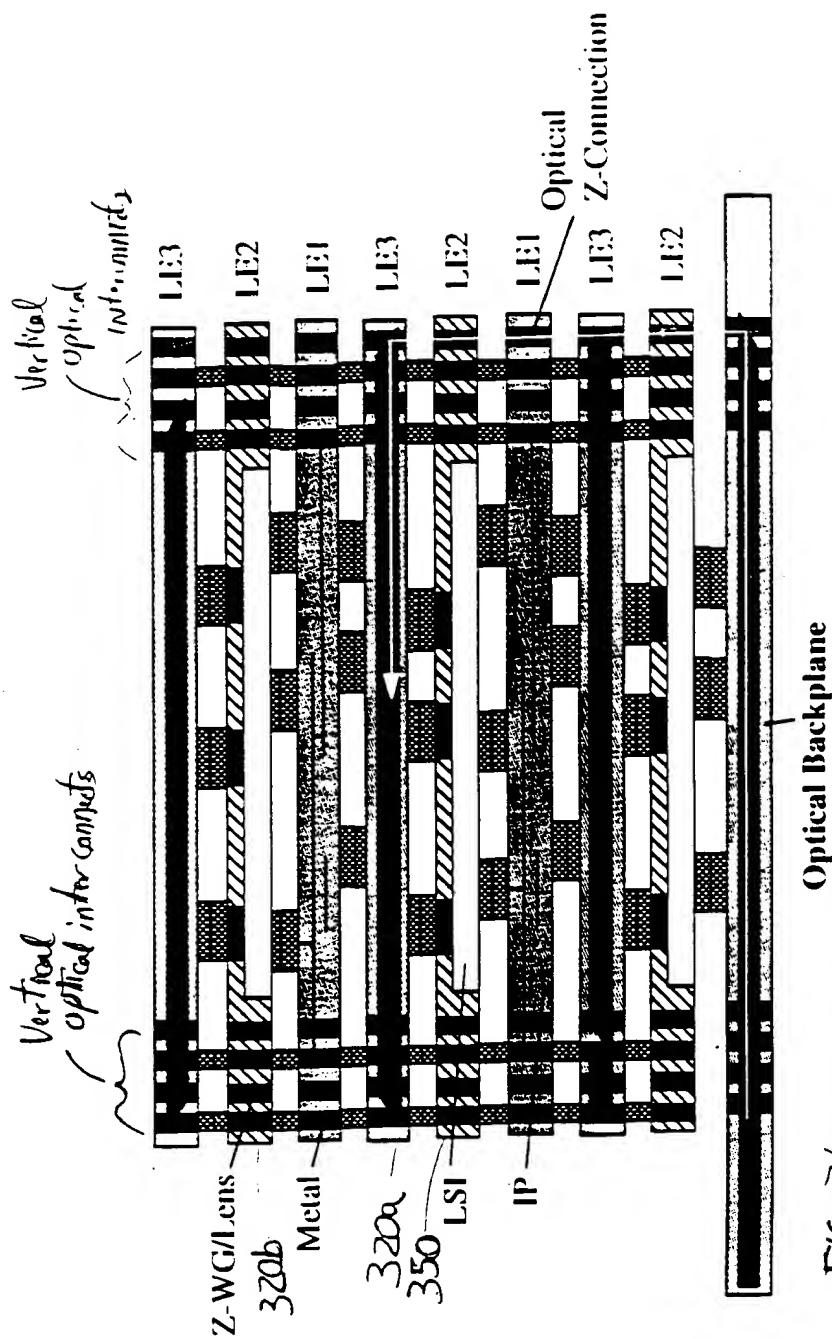


FIG. 71

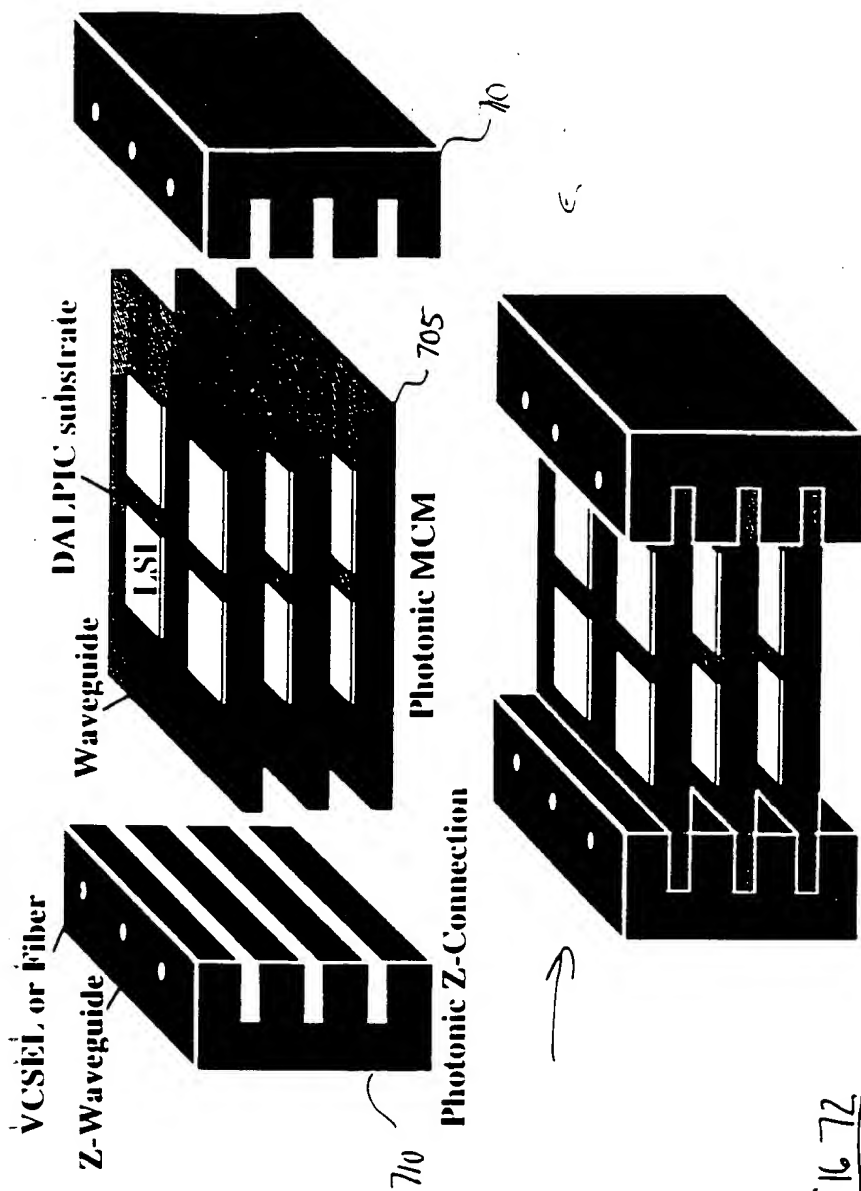
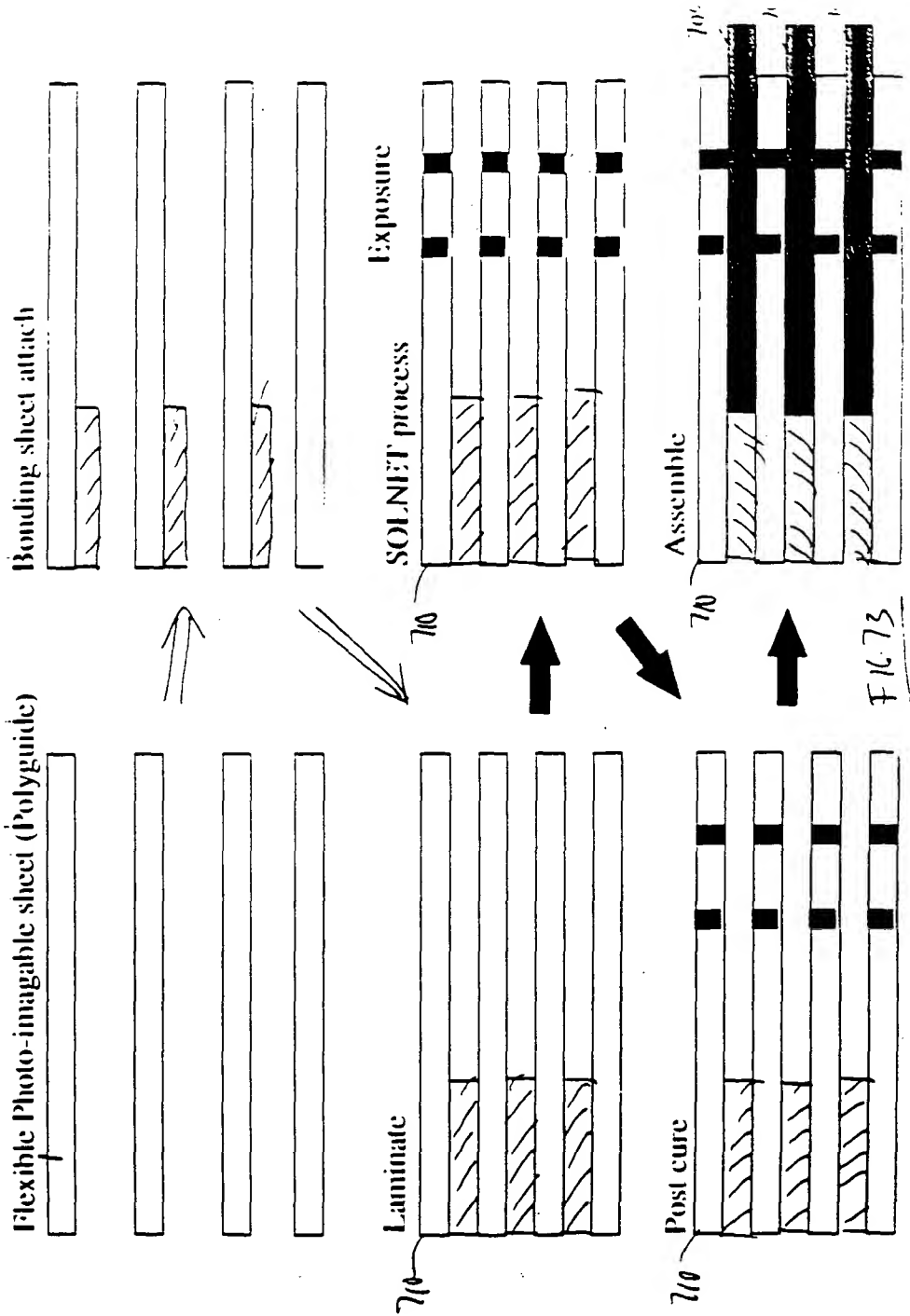
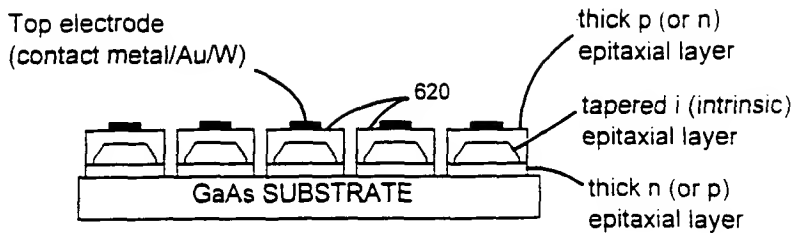
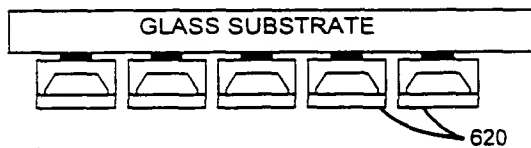


FIG 72

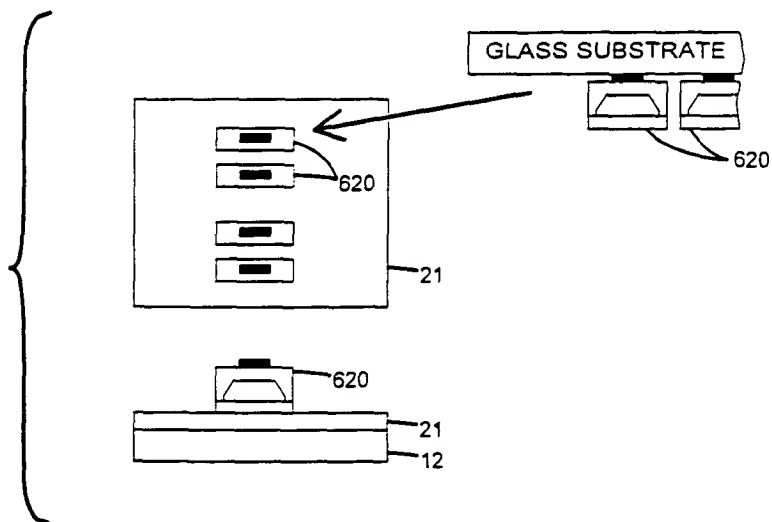




**FIG.\_74** (Epitaxial growth and patterning)



**FIG.\_75** (Epitaxial lift-off)



**FIG.\_76** (Transfer)



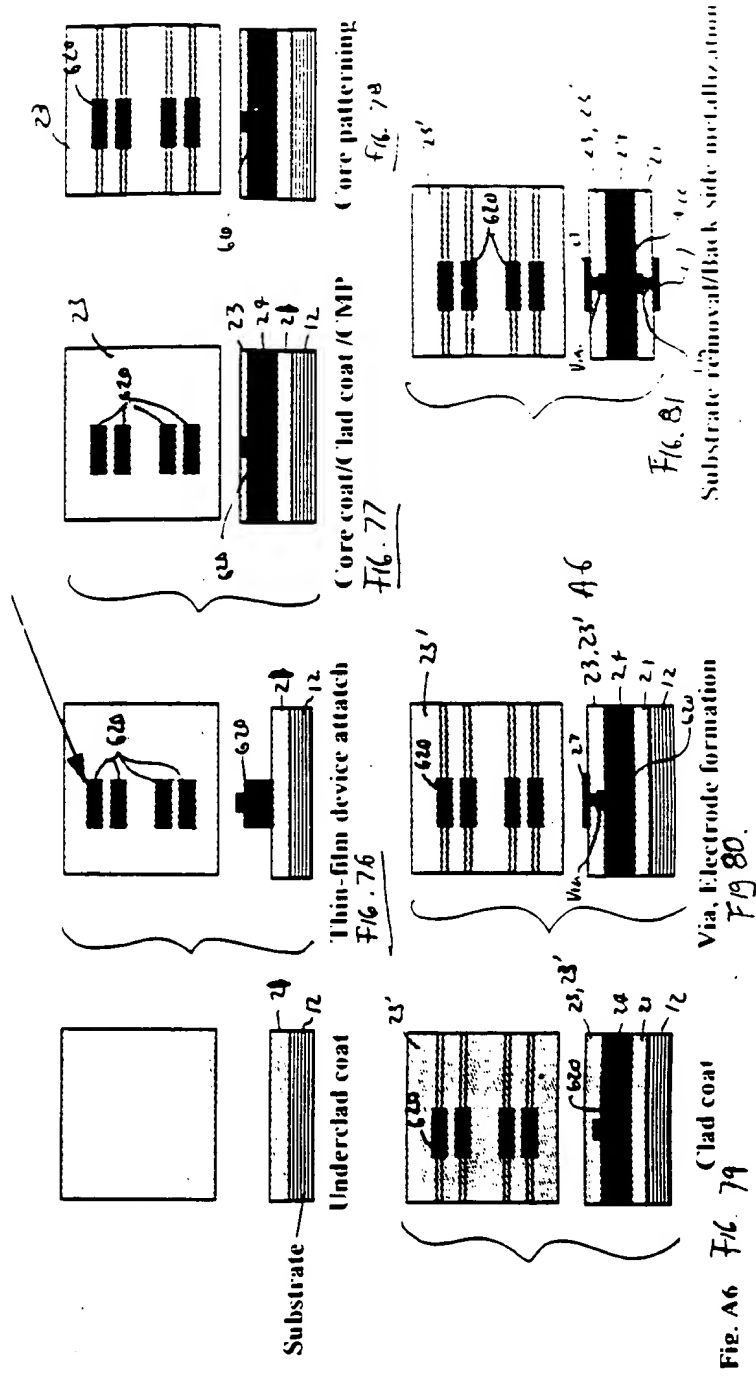
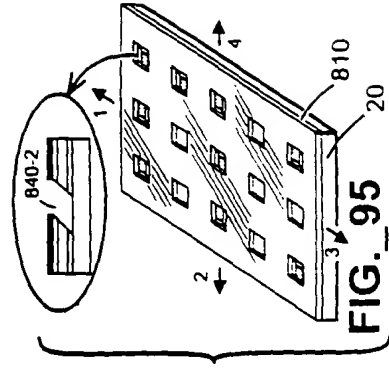
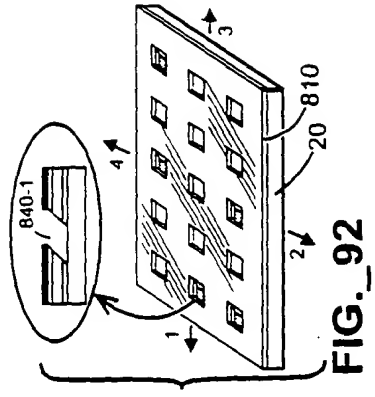
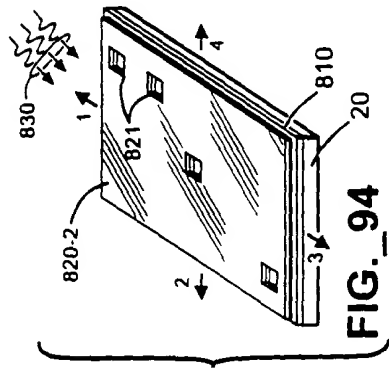
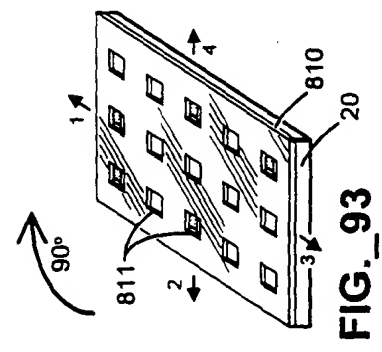
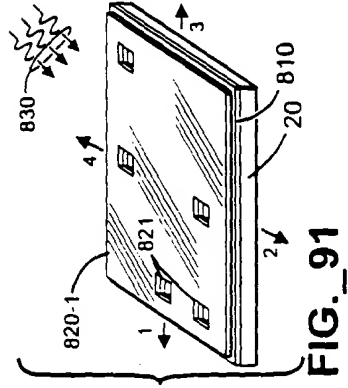
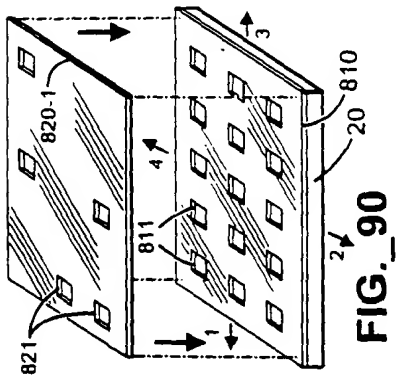
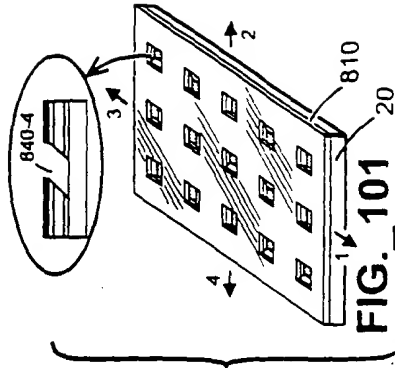
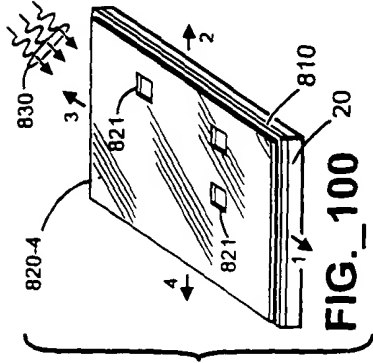
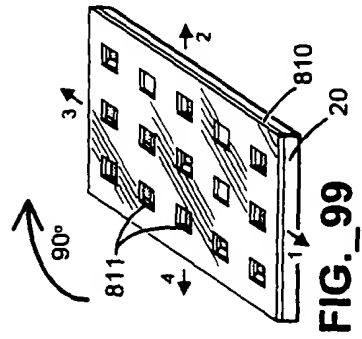
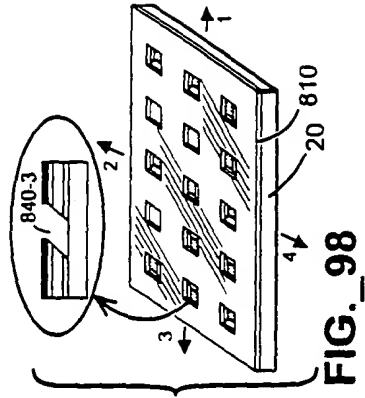
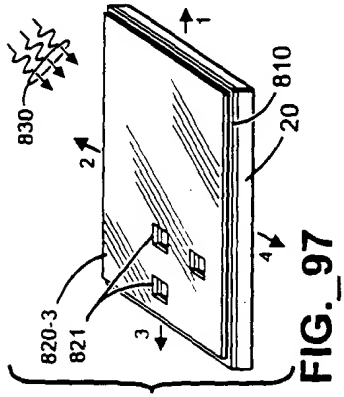
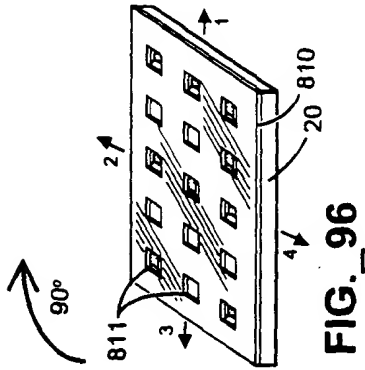


Fig. A6









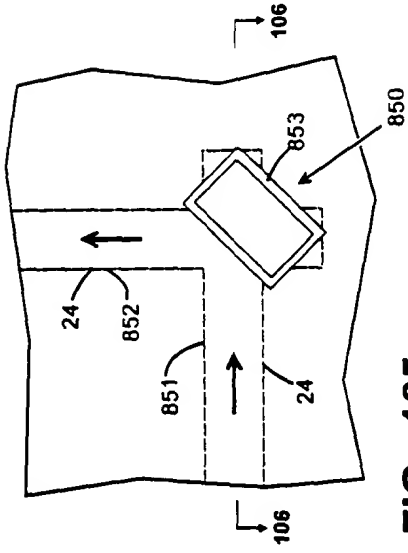


FIG. 105

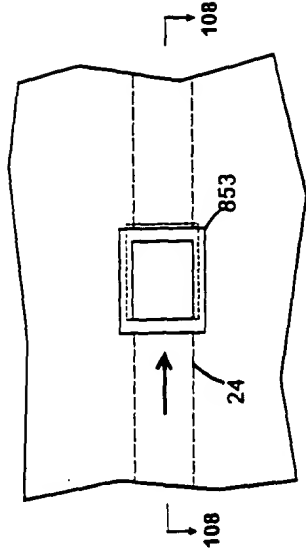


FIG. 107

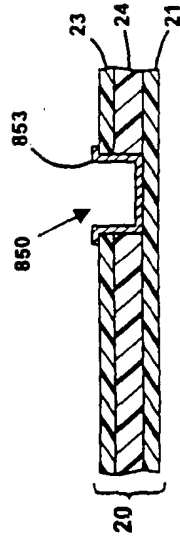


FIG. 106

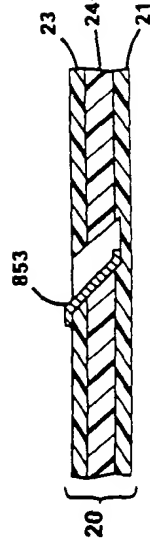
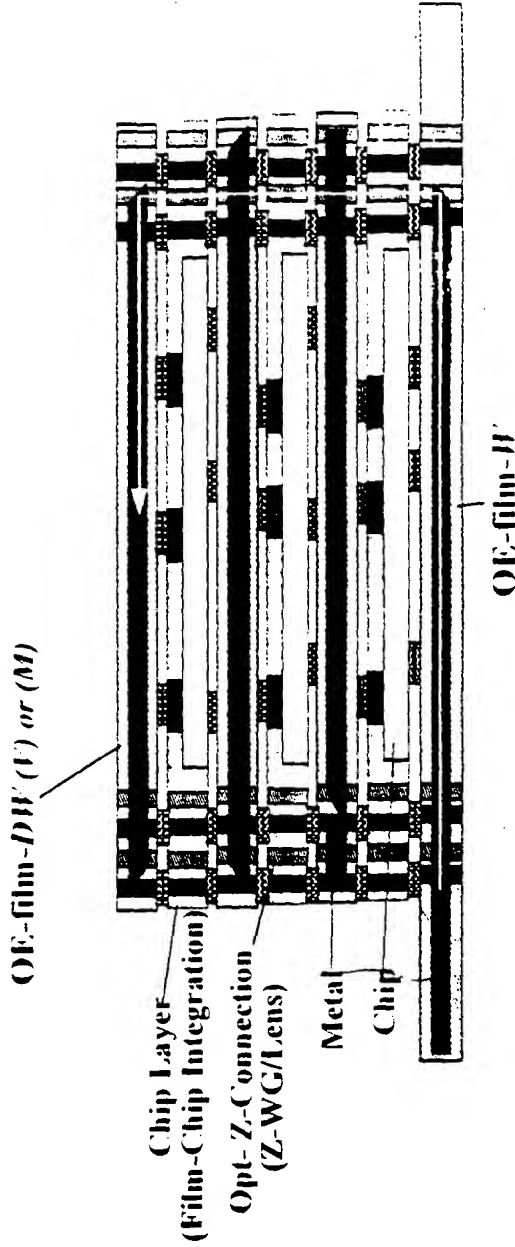


FIG. 108

FUJITSU Computer Packaging Technologies, Inc. **FCPT**  
**GS CX/CXX OE Solution --- OE-3D-Stack**



A 22

FIG. 109

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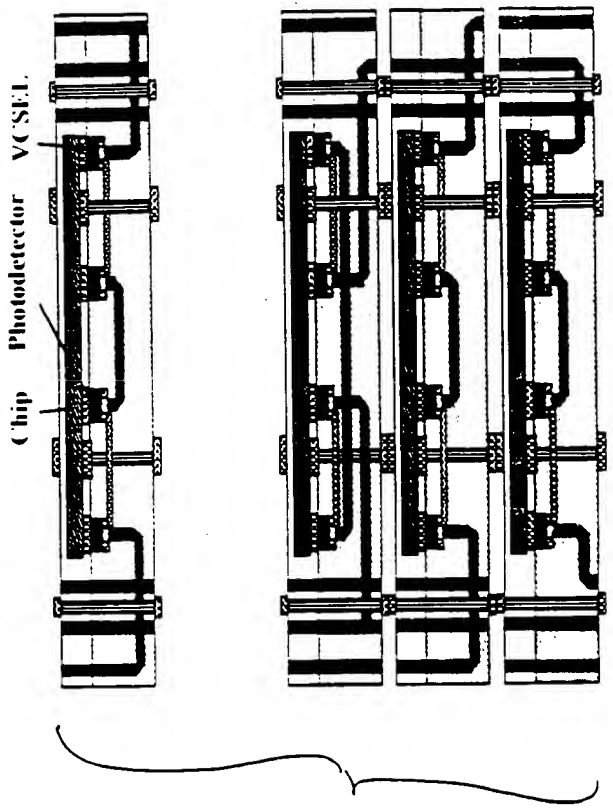


Fig. 110

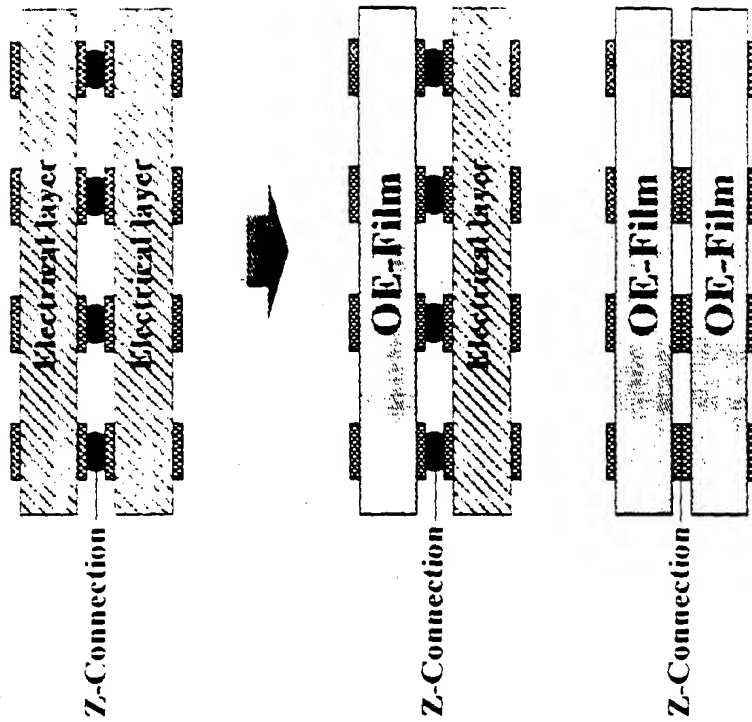
A23

(2/23/99) AA1 Detail picture Example for 3D-stack'  
(New version of the AA1 of 2/5/99)



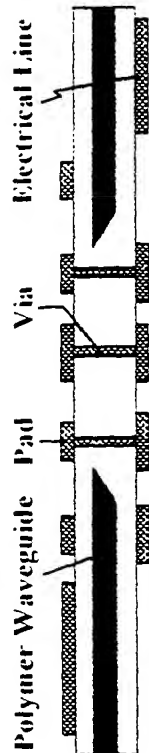
A24

(New version of the AA2 of 2/5/99)



2/23/99-added 1

## OE-Films



OE-film-W

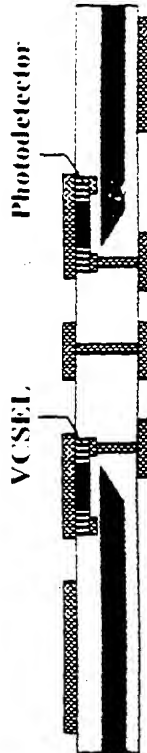
F16.113



OE-film-D

F16.114

A8



OE-film-DW(V)

F16.115



OE-film-DW(M)

2/17/99-added 2

F16.116



**FOLM**

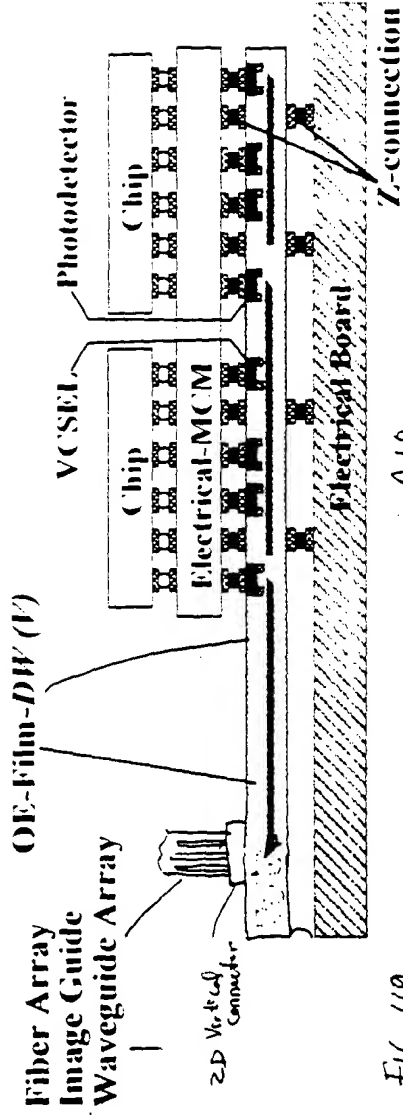
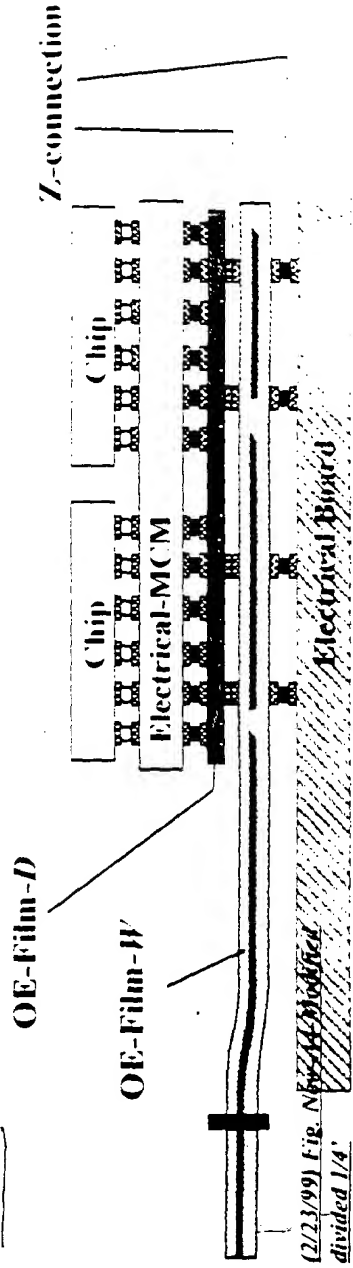


Fig. 119



(2/23/99) Fig. No. 119 Modified divided 1/4

Fig. 120

204000 2252450

**FUJITSU** Computer Packaging Technologies, Inc. **FCPT**  
**FOLM with Optical Path Length Controller, Connector Buffer**

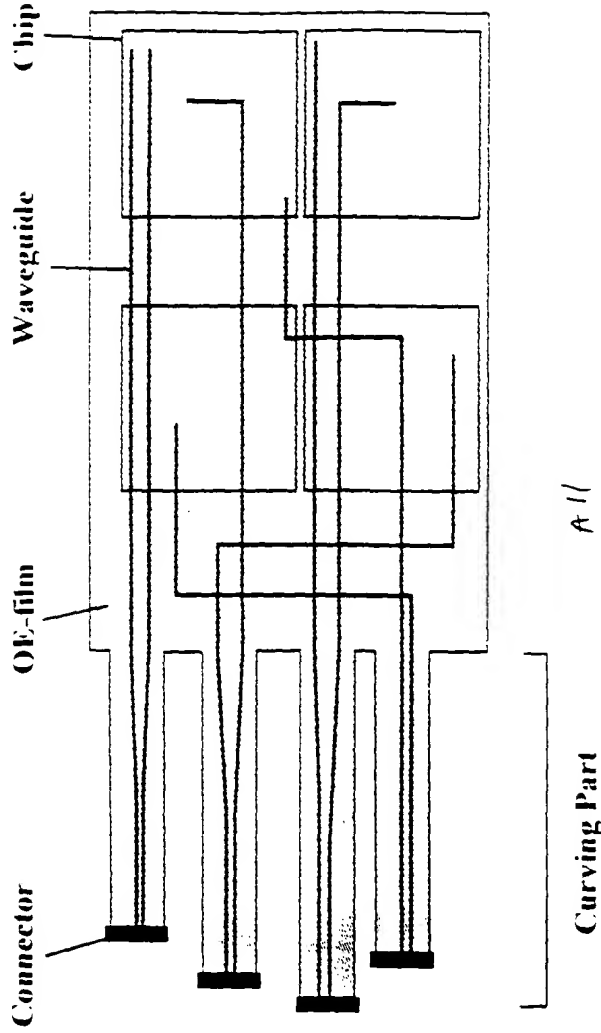


Fig. 121

(2/17/99) Fig. New-A4-Modified  
divided 2/4

FUJITSU Computer Packaging Technologies, Inc. — FCPT  
**FOLM with Optical Path Length Controller, Connector Buffer**

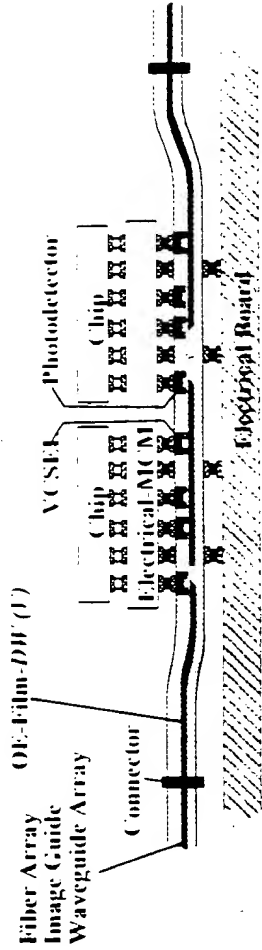


FIG. 123

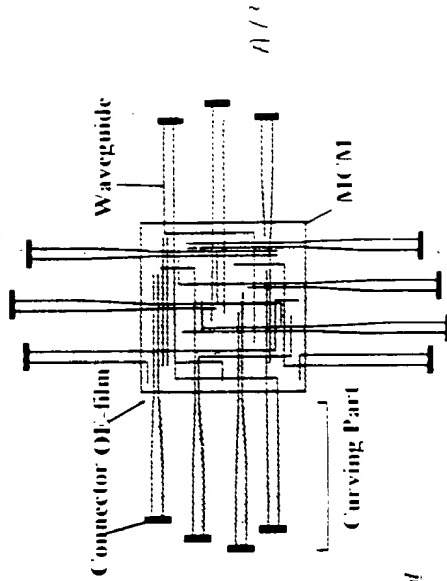
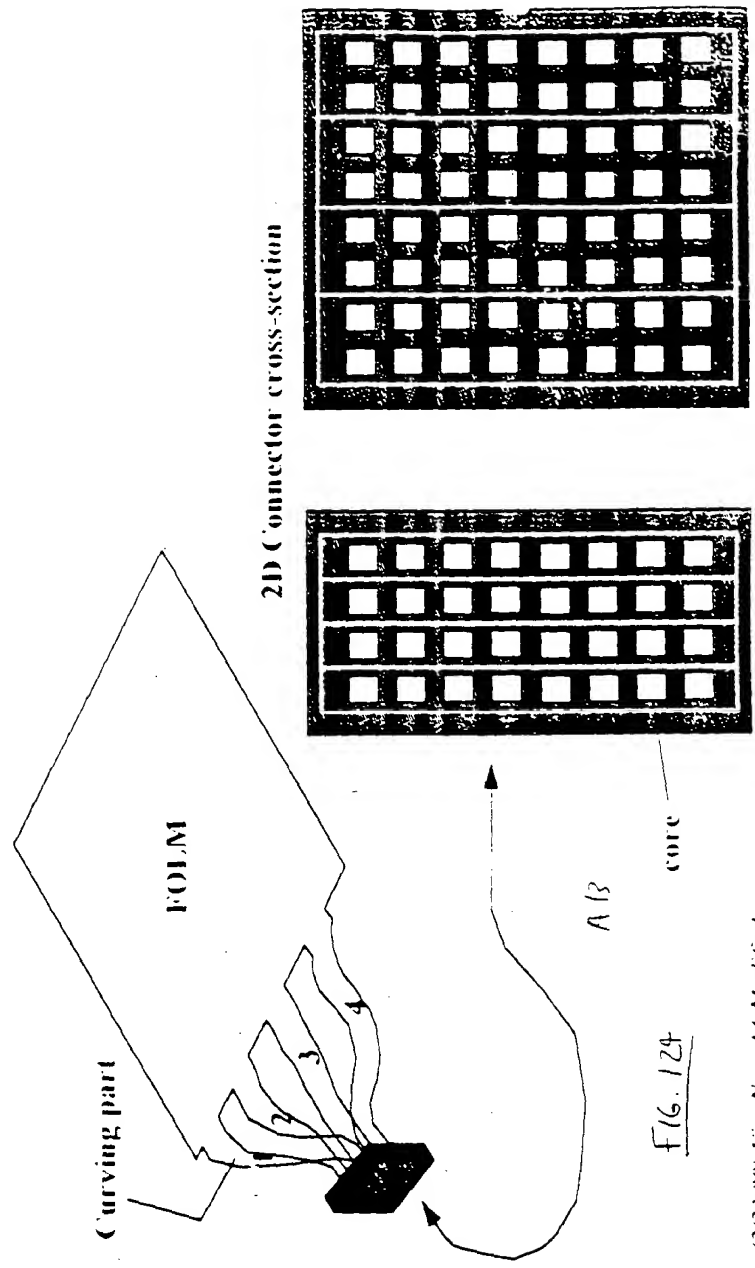


FIG. 122

(2/21/99) Fig. New-44-Modified  
 divided 2/4

FUJITSU Computer Packaging Technologies, Inc. **FCPT**  
**FOLM with 2D Waveguide Connector**



(for Single-layer waveguide) (for 2 layer waveguide)

(2/24/99) Fig. New-A4-Modified divided 3/4



FUJITSU Computer Packaging Technologies, Inc. — FCPT  
**FOI.M: High-Speed Option**

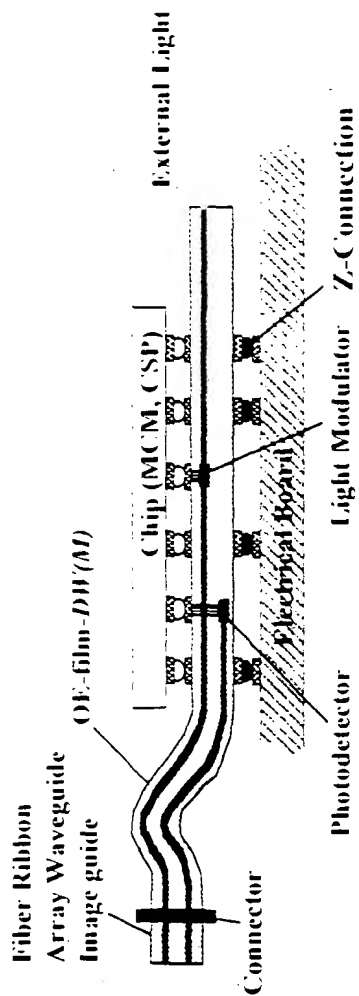
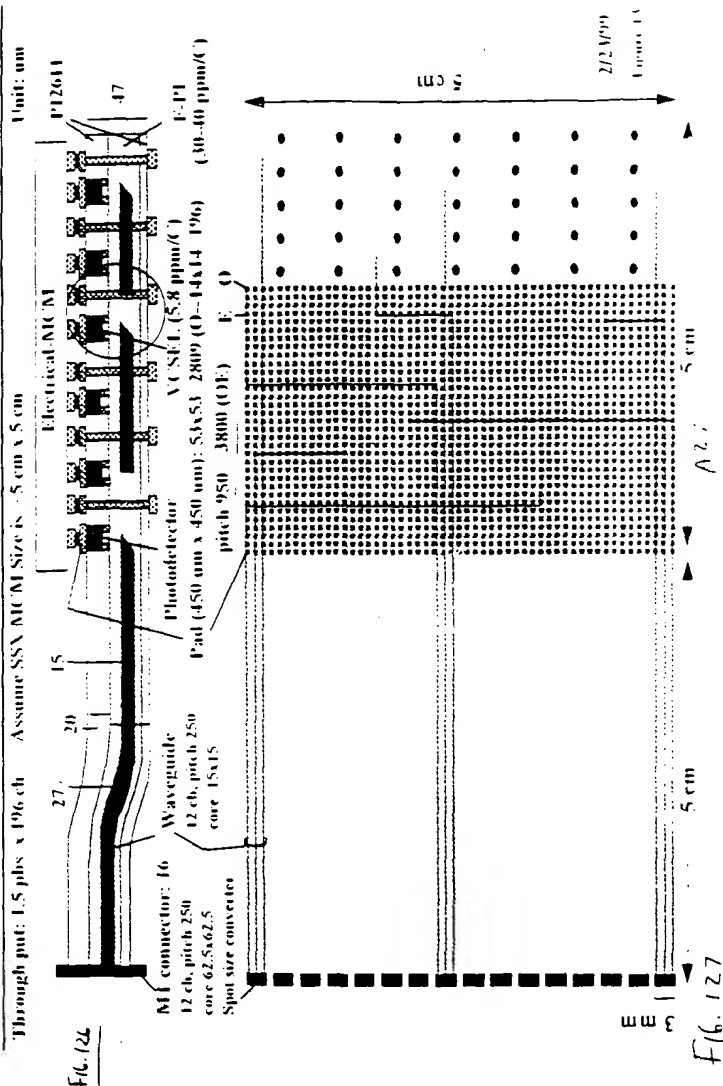


Fig. 125

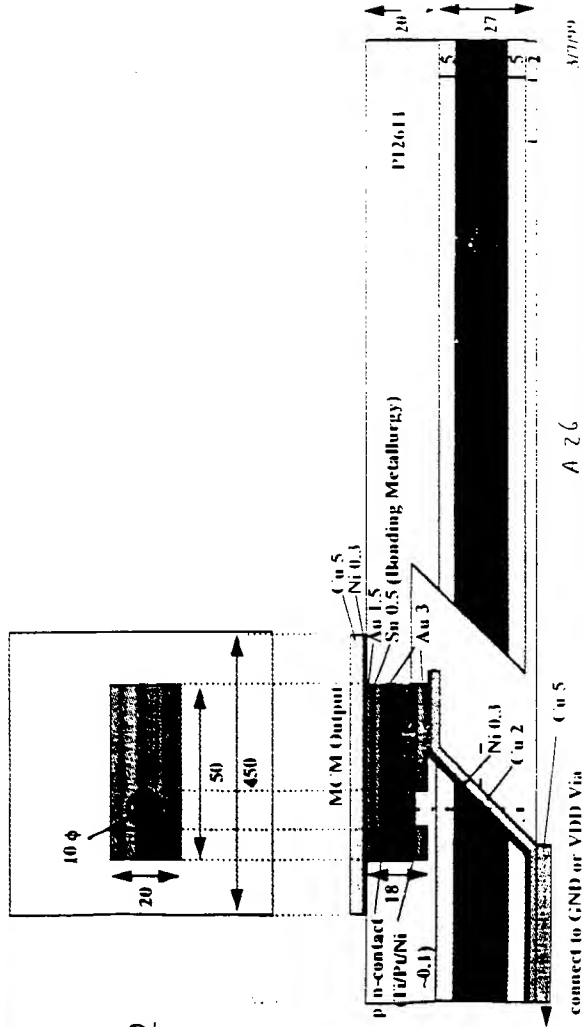
9/14

204040 225/2/53

# FOLM Structure Example (Overall)



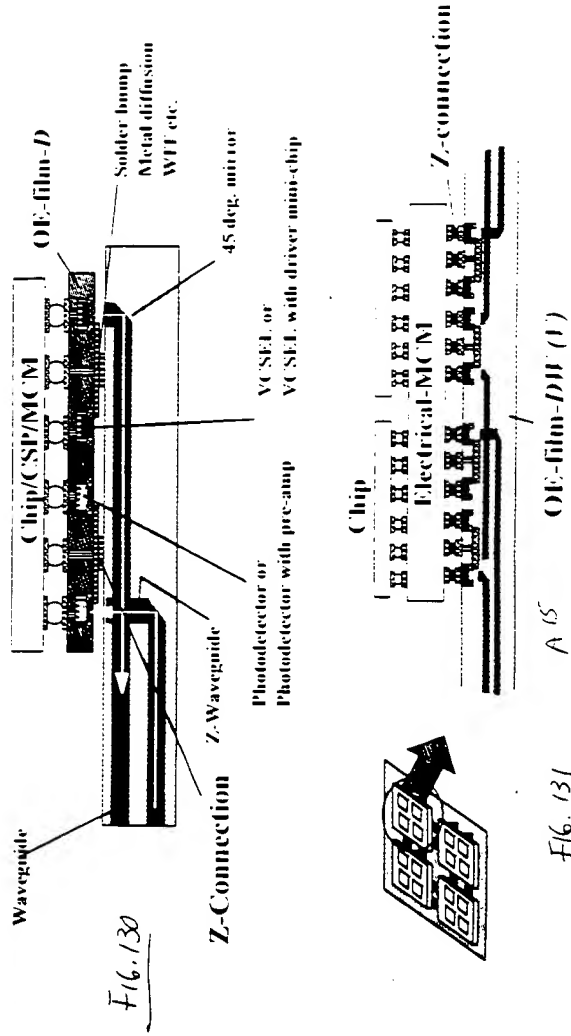
FUJITSU Computer Packaging Technologies, Inc. **FCPT**  
**FOLM Structure Example (VCSEL, part)**



Unit :  $\mu\text{m}$

Fig. 12B

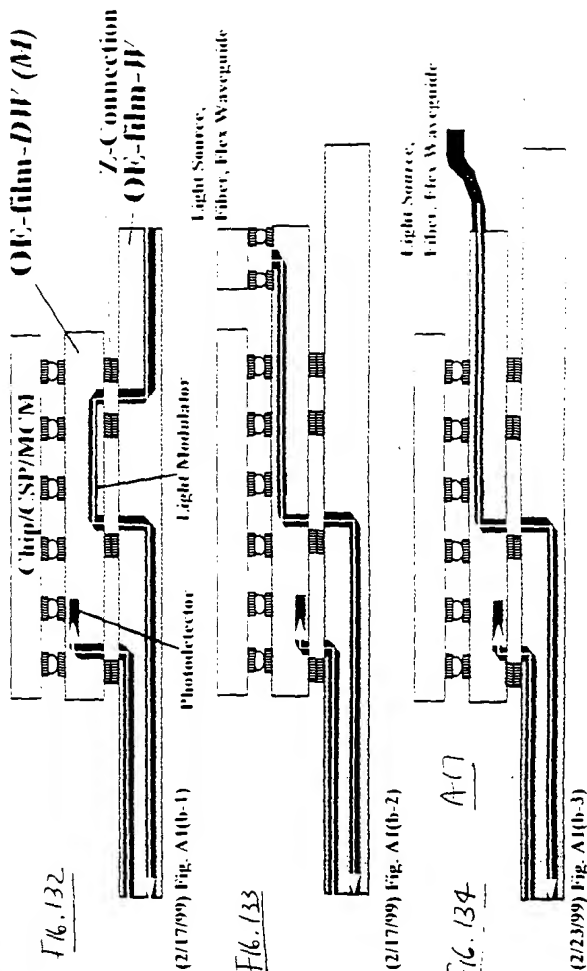
FUJITSU Computer Packaging Technologies, Inc. **FCPT**  
**OE-film: OE-IP, OE-Film-MCM**



F16.130  
 F16.131  
 A 15  
 F16.131  
 A 15  
 OE-film-DB (1)  
 (2/23/99) Fig. New-A1-Modified

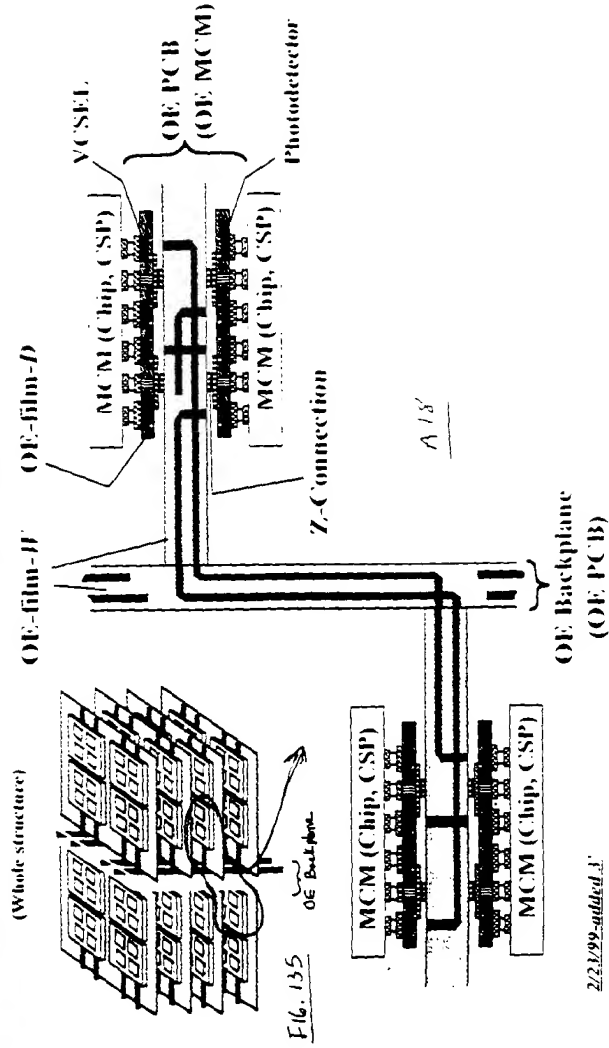
2004040 2004040

<sup>67</sup>  
Fujitsu Computer Packaging Technologies, Inc. — FCPT  
OE-film: Light Modulator Transmitters



Examples of Light Modulators: Electro-Optic (EO) Modulator, Electro-Absorption (EA) Modulator

# OE-film: Both-Side Packaging



# Direct Jump from LSI

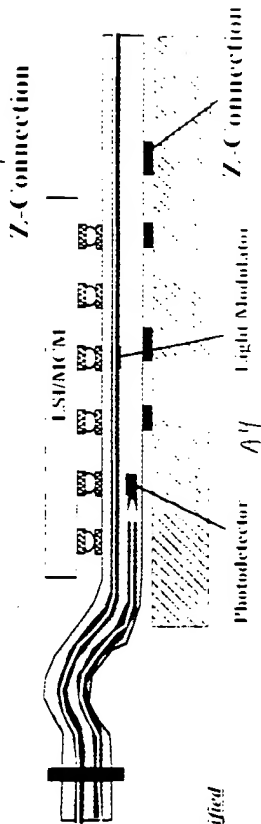
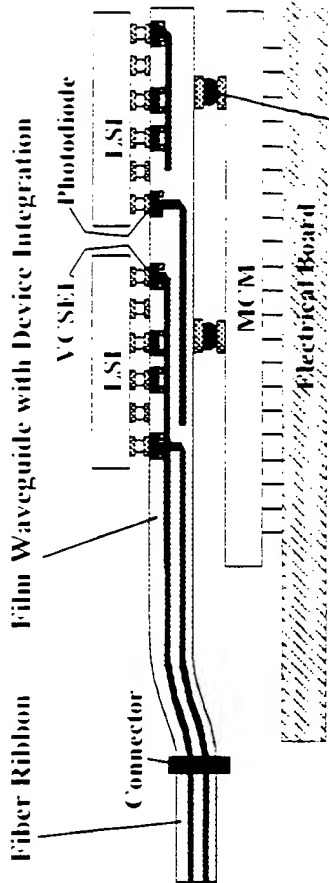
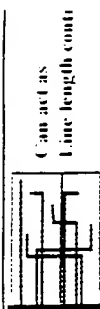
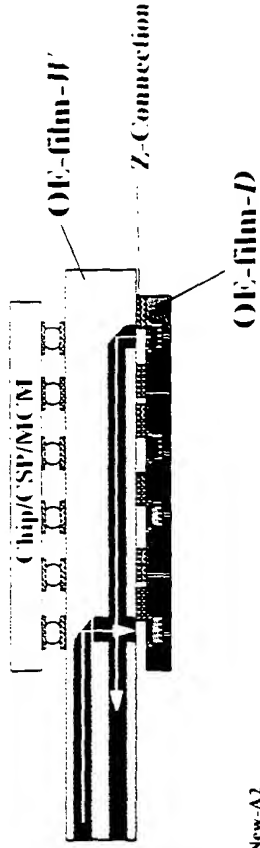


Fig. New-14-Modified

Computer Packaging Technologies, Inc. — FCPT

**OE IP is Placed on the Opposit Side**



(2/23/99) Fig. New-A2

Flg. 138





<sup>62</sup>  
FUJITSU Computer Packaging Technologies, Inc. — FCPT  
OE-film: Smart Pixel



Fig. 141

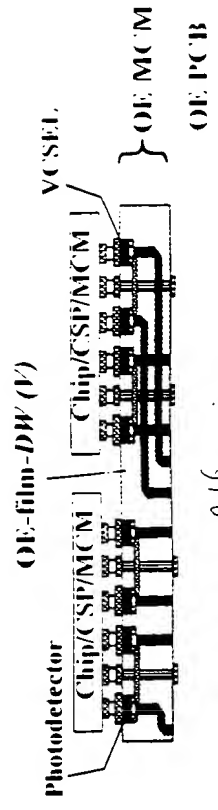


Fig. 142

OE-Film/OE-Film Stack --- Back-Side Connection

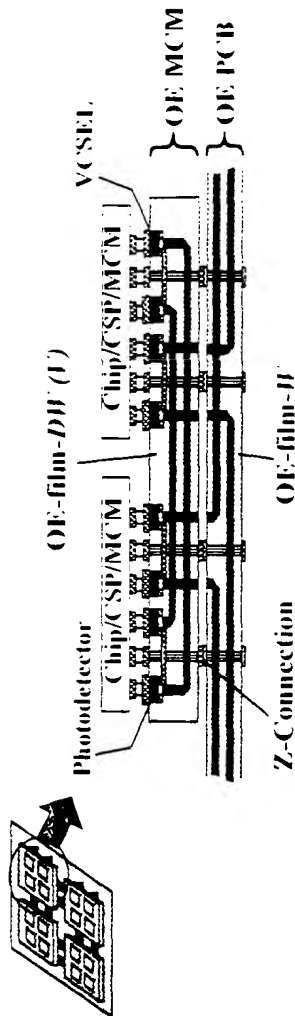
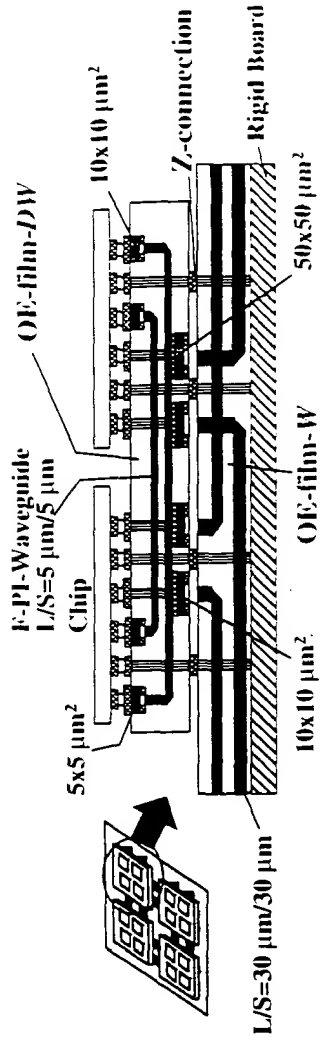


FIG. 14B

FUJITSU Computer Packaging Technologies, Inc. — FCPT  
 OE-Film/OE-Film Stack --- Back-Side Connection



D1

FIG. 144

FUJITSU Computer Packaging Technologies, Inc. **FCPT**  
**OE-MCM/OE-Bord Stack**

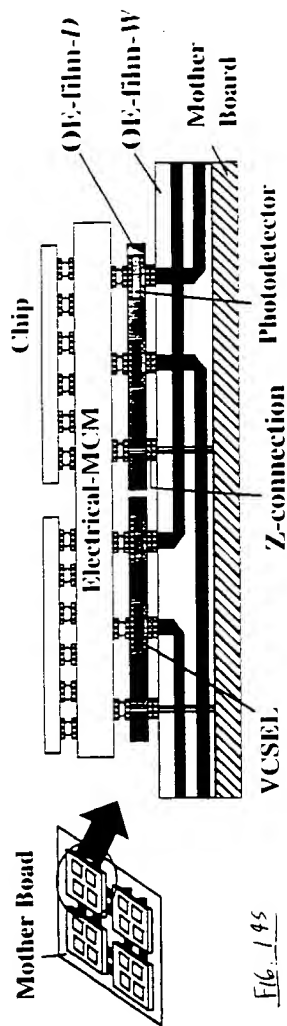


Fig. 145

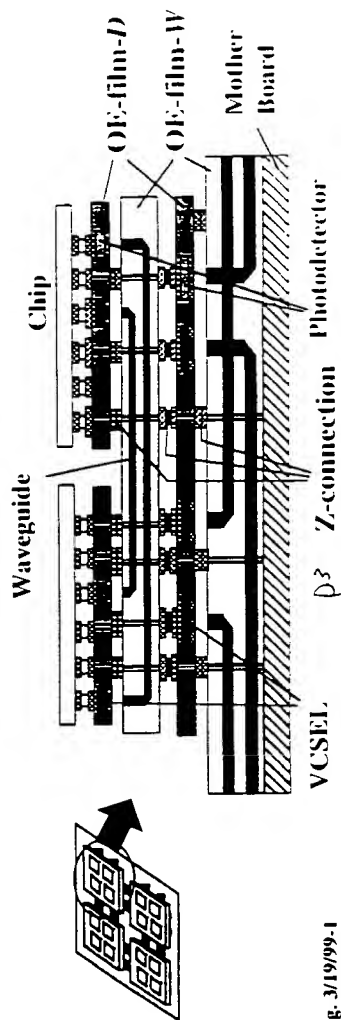



Fig. 3/19/99-1

Fig. 146

D3 3/18/99

## Device Integration Process

(1) Pads/Lines formation  Fig. 147

(2) Placement of Thin film devices  Fig. 148

(3) Polymer coat  Fig. 149

(4) Planarization  Fig. 150

(5) Vias/Pads/Lines formation  Fig. 151

(6) Substrate removal  Fig. 152  
OE-film-D  
A 2 /

(6') Jump to the waveguide formation process  Fig. 153  
OE-film DD(1)



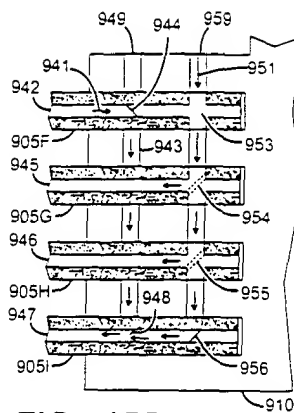


FIG. 155

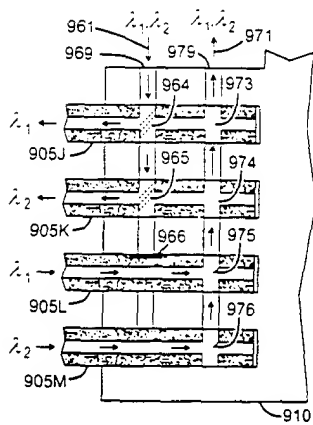


FIG. 156-1

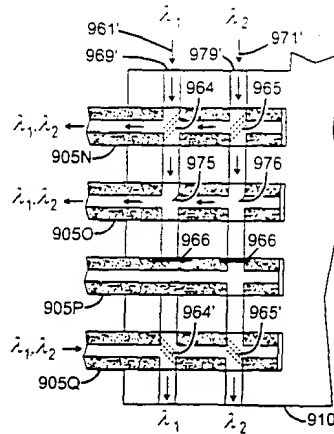


FIG. 156-2



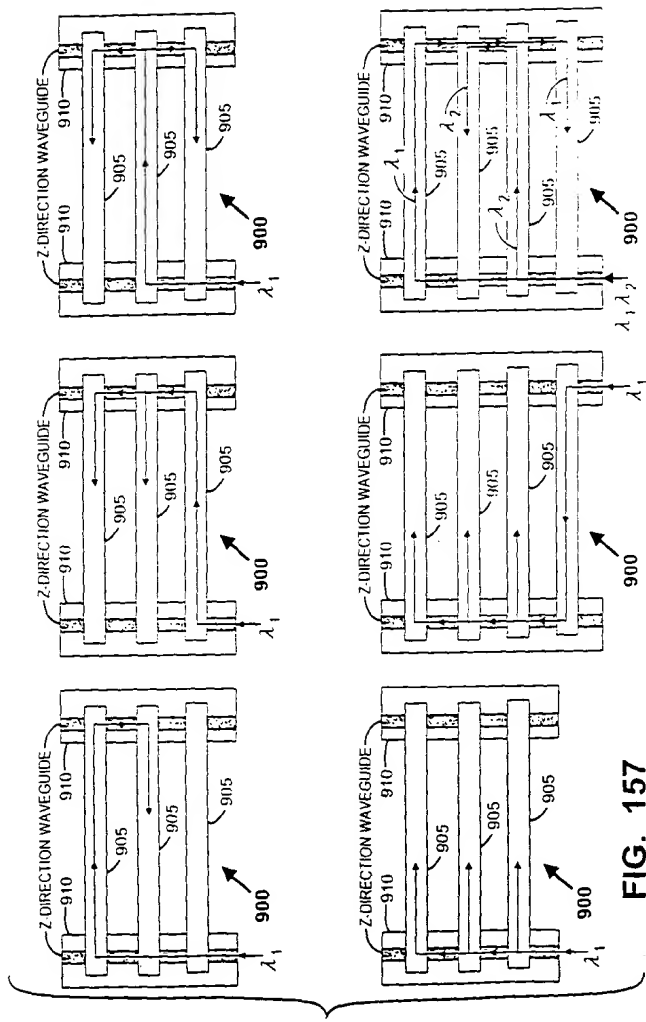


FIG. 157

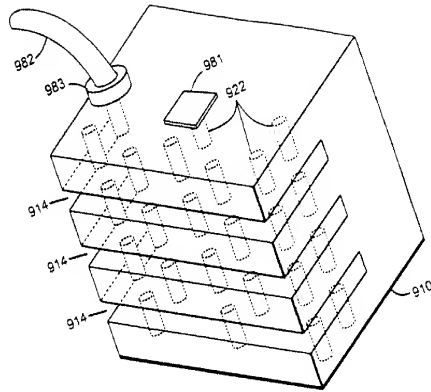


FIG. 158

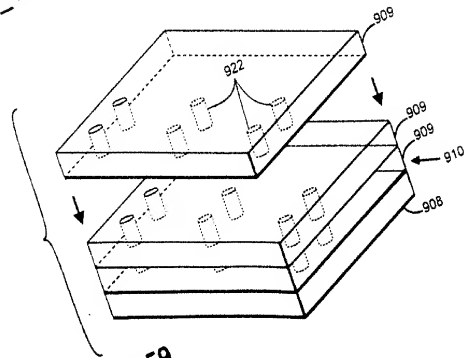
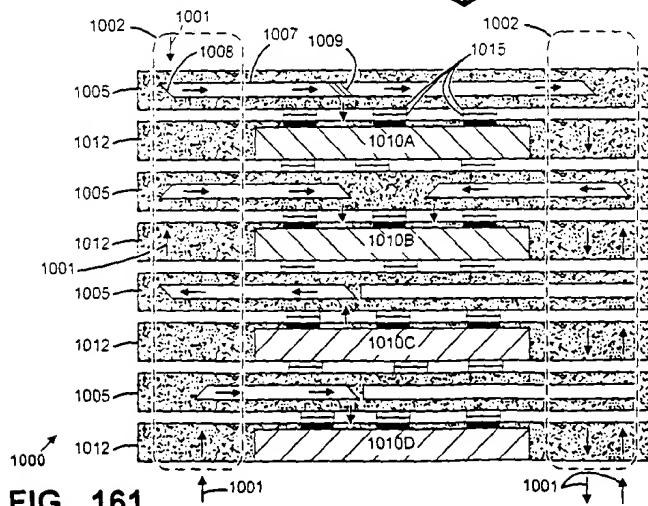
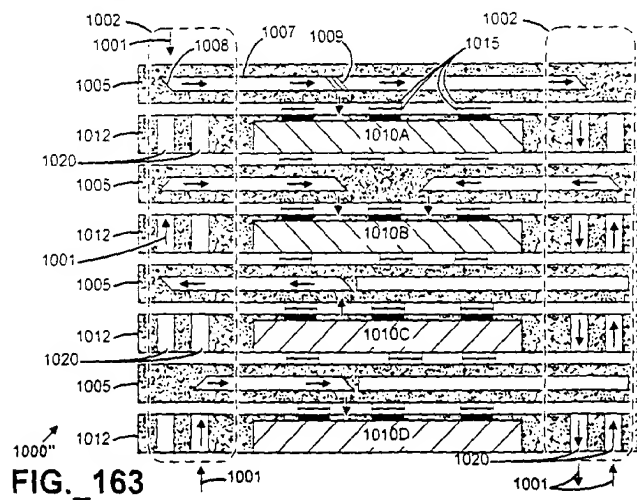
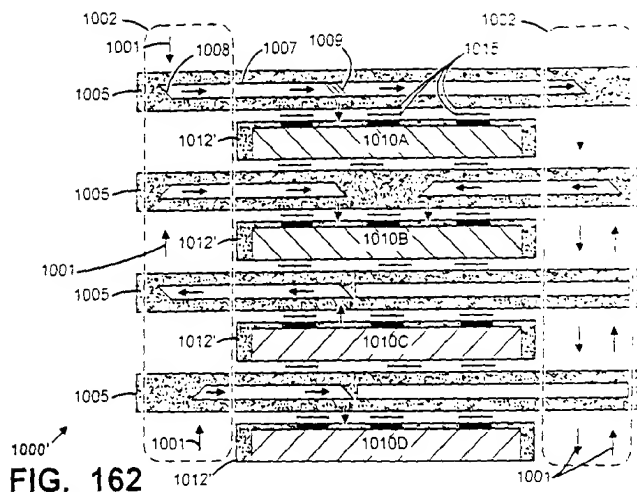
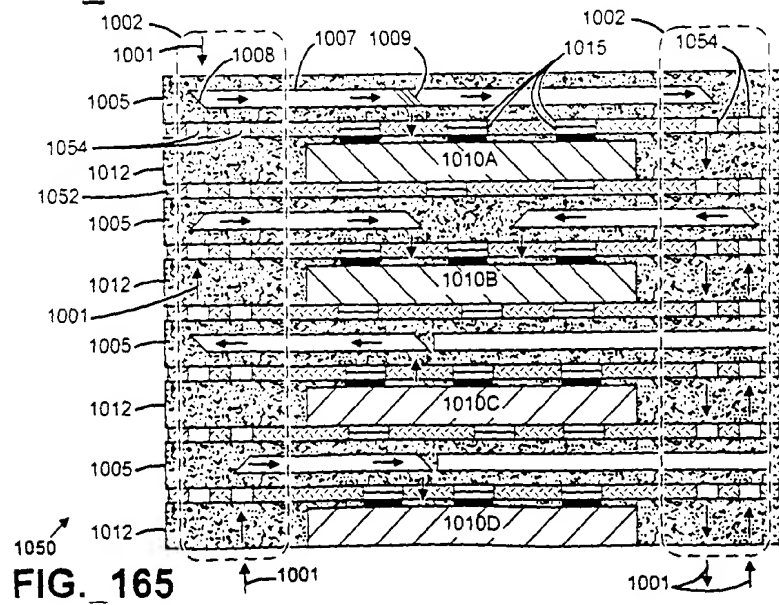
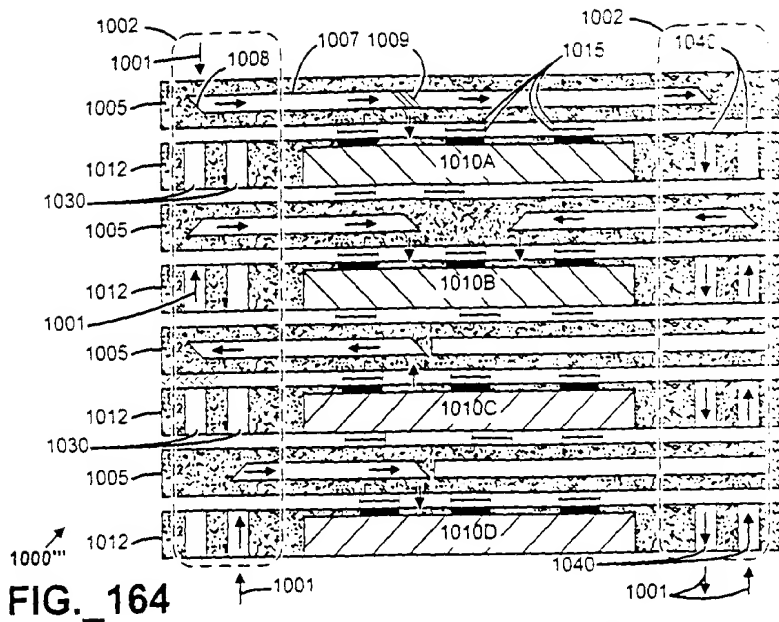


FIG. 159







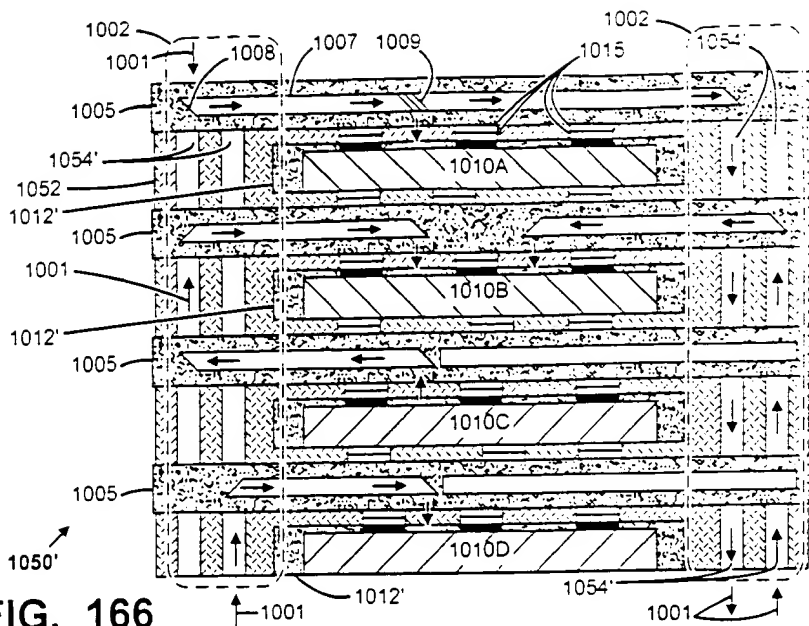


FIG. 166

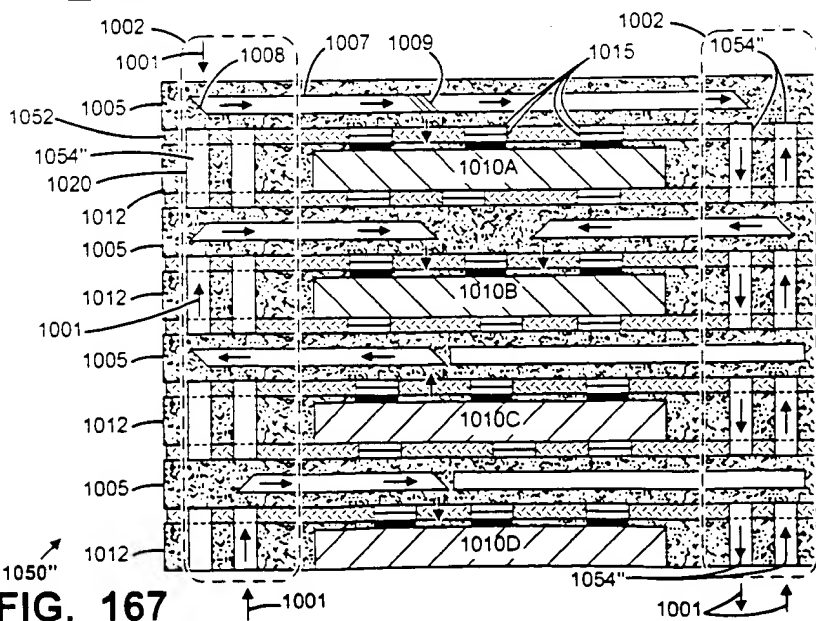


FIG. 167

2025-09-26

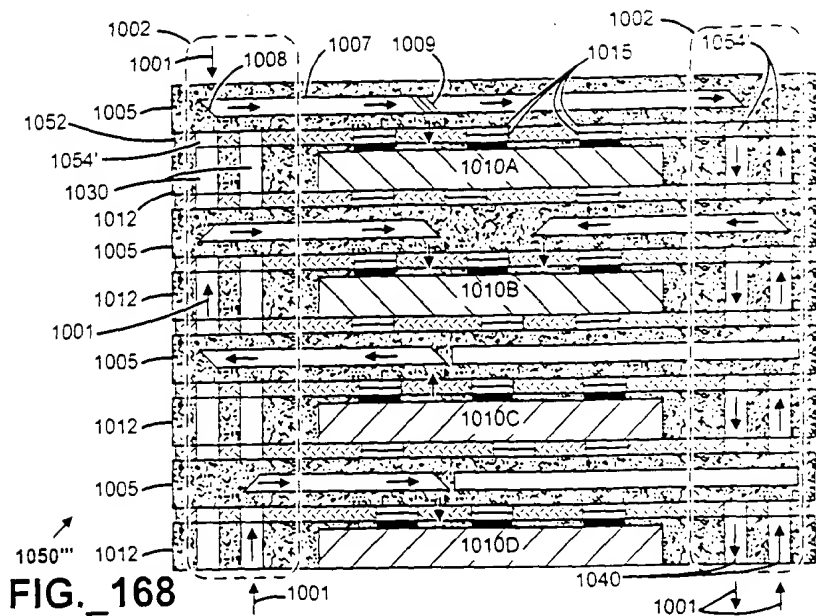


FIG. 168

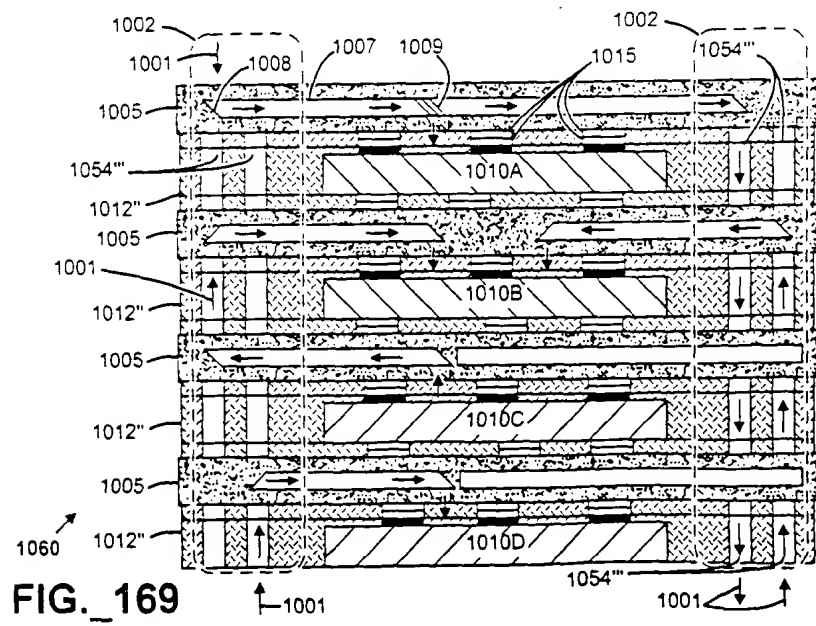


FIG. 169

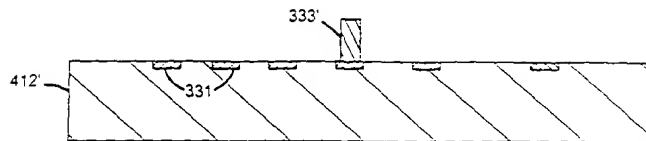


FIG. 170

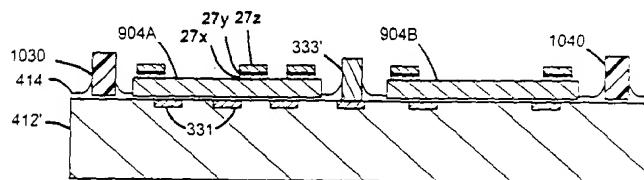


FIG. 171

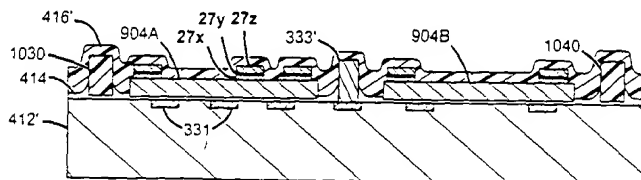


FIG. 172

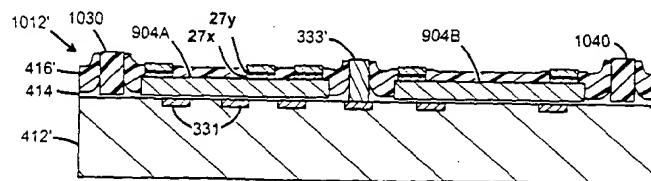
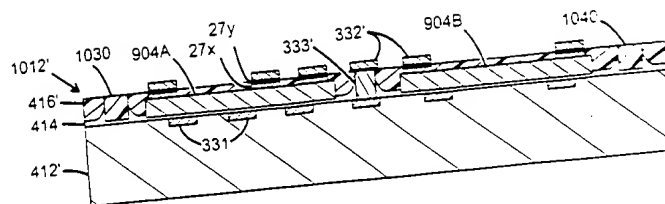
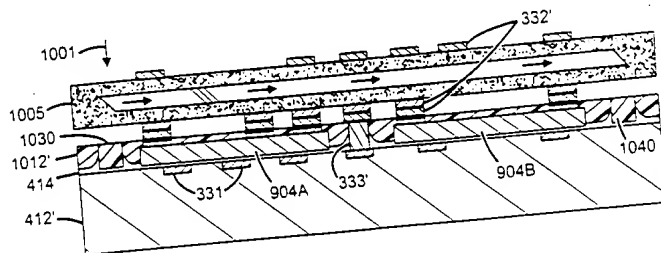


FIG. 173

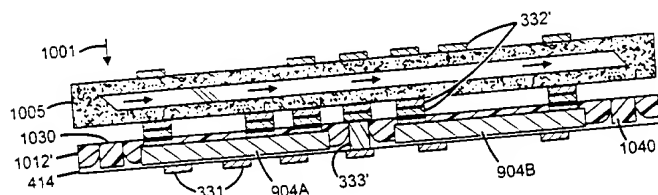




**FIG. 174**



**FIG. 175**



**FIG. 176**

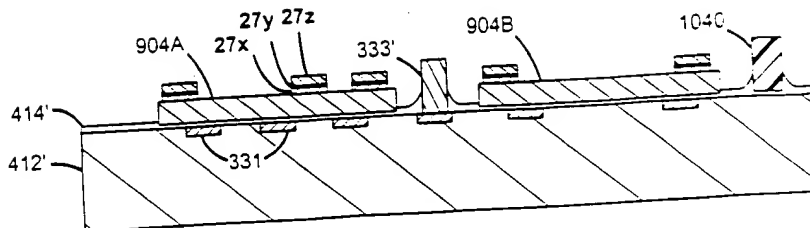


FIG. 177

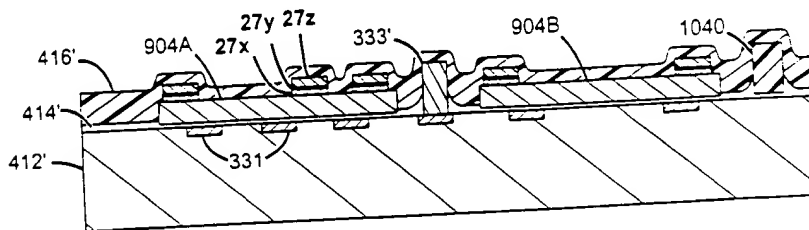


FIG. 178

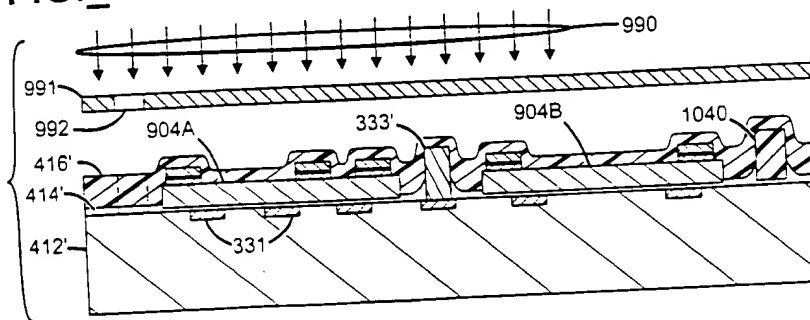


FIG. 179

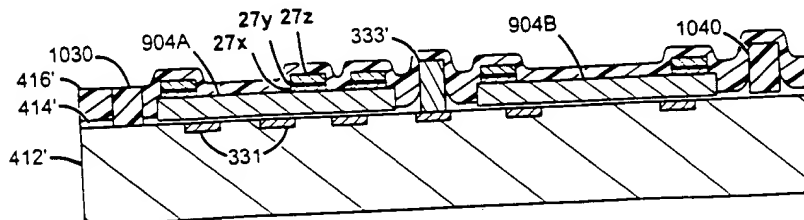
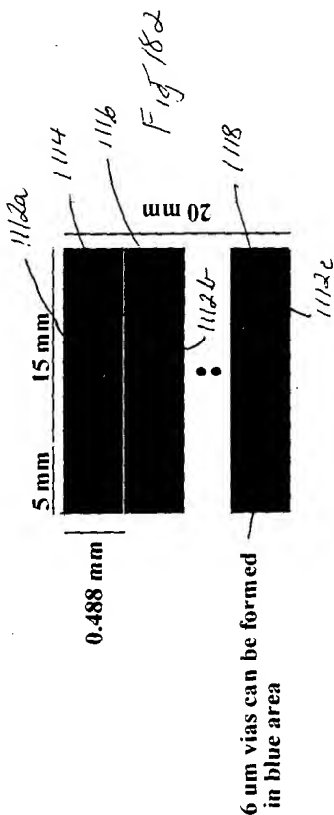
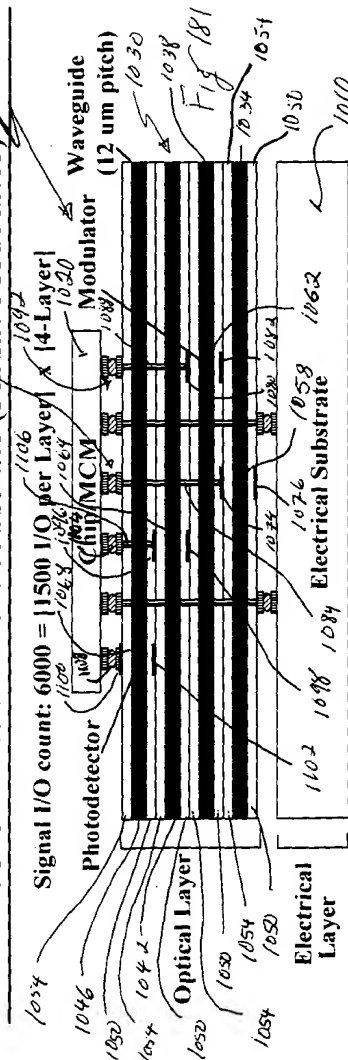
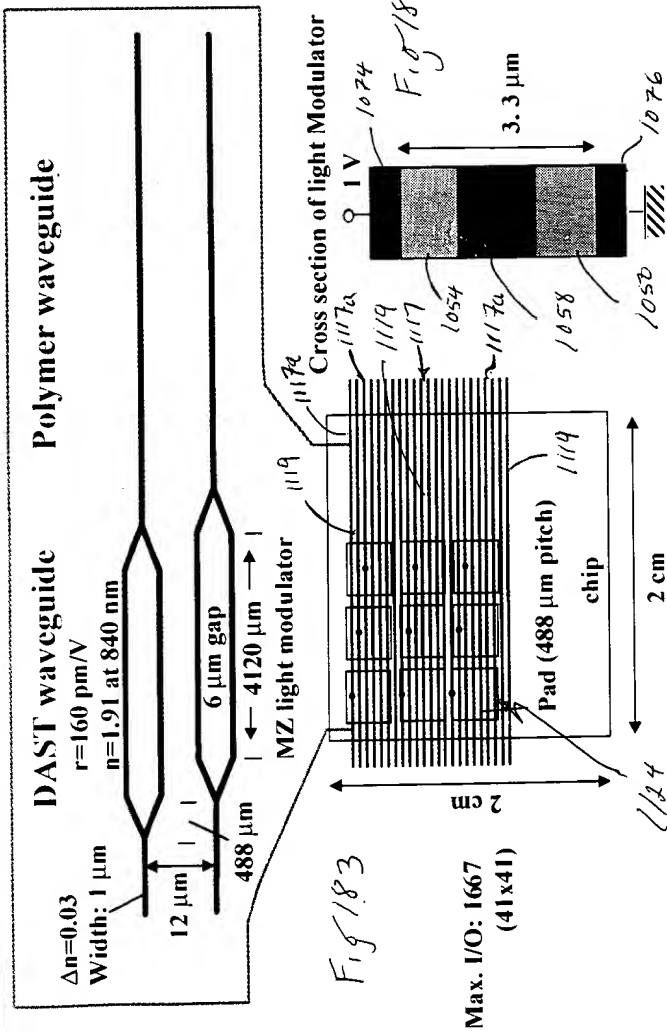


FIG. 180

# I/O Connection in OE Substrate (Planar Modulator)





## I/O Connection in OE Substrate (OE-VLSI)

**Signal I/O count: 6000 = [1500 I/O per Layer] x [4-Layer]**

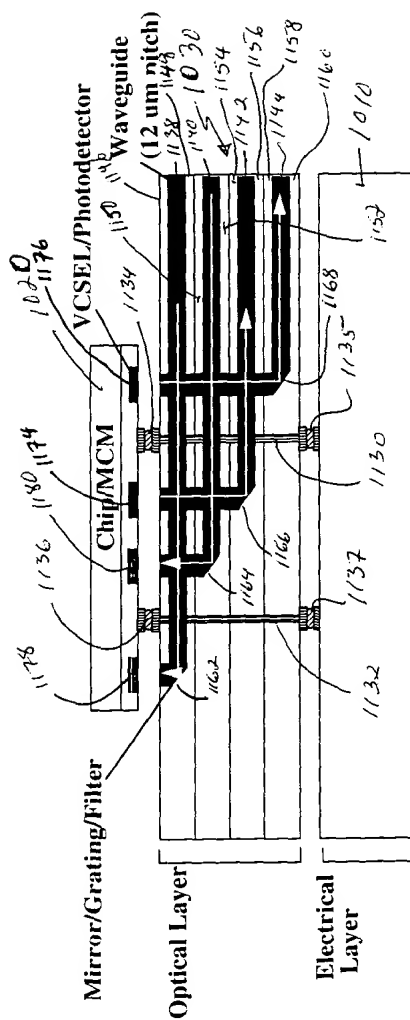
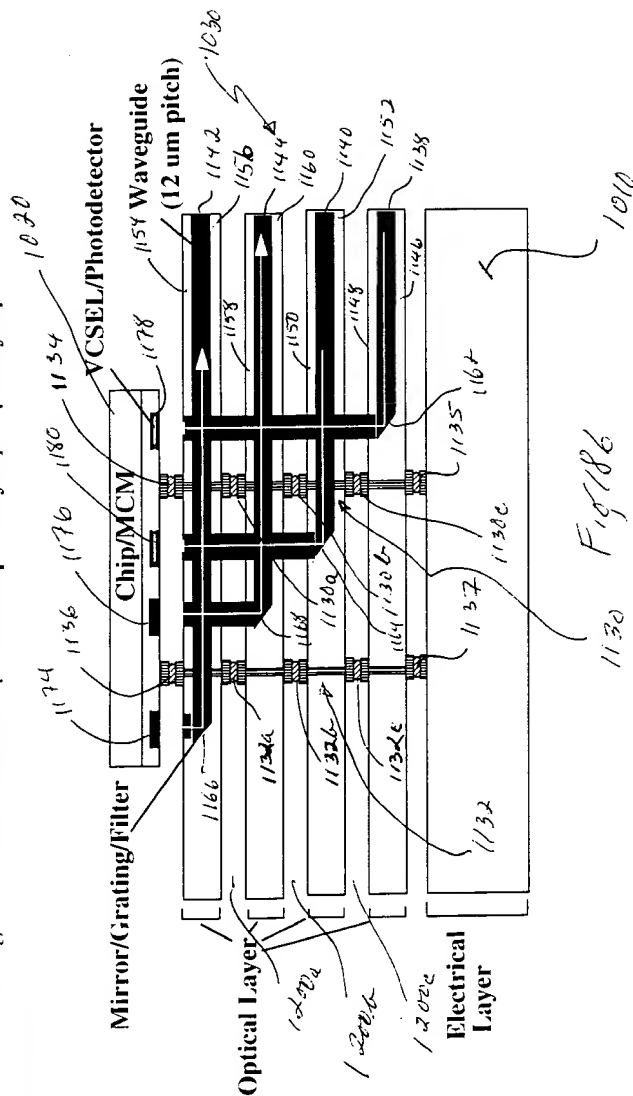


Fig 185-

## I/O Connection in OE Substrate (OE-VLSI)

**Signal I/O count: 6000 = [1500 I/O per Layer] x [4-Layer]**



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FUJITSU Computer Packaging Technologies, Inc. **FCPT**  
**I/O Connection in OE Substrate (OE-VLSI, WDM)**

Signal I/O count: 6000 = [1500 I/O per Layer] x [4-Layer]

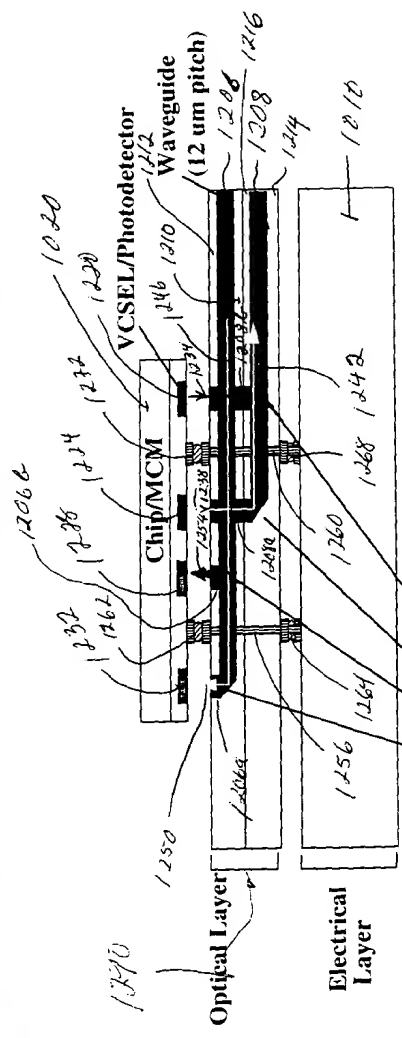


Fig 187

Grating/Filter

**FUJITSU** Computer Packaging Technologies, Inc. **FCPT**

## I/O Connection in OE Substrate (OE-VLSI, WDM)

**Signal I/O count: 6000 = [1500 I/O per Layer] x [4-Layer]**

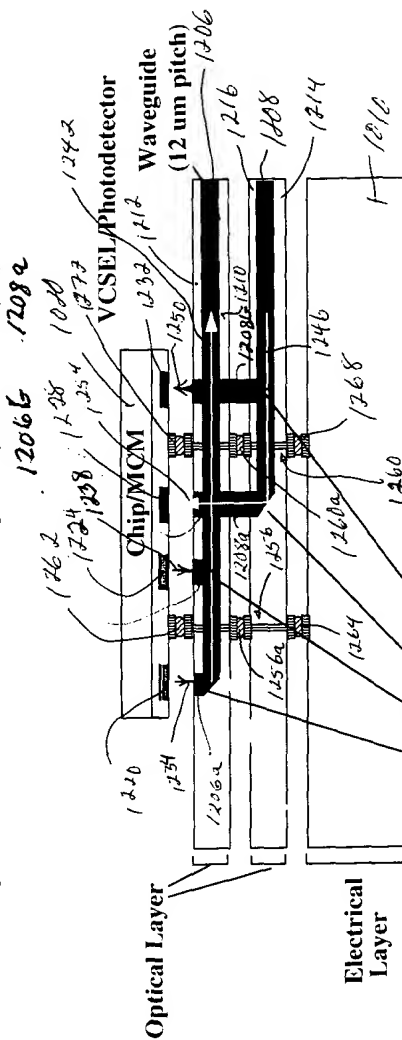


Fig 188

## Grating/Filter



Fujitsu Computer Packaging Technologies, Inc. **FCPT**  
**I/O Connection in OE Substrate (Active OE Layer)**

Signal I/O count: 6000 = [1500 I/O per Layer] x [4-Layer]

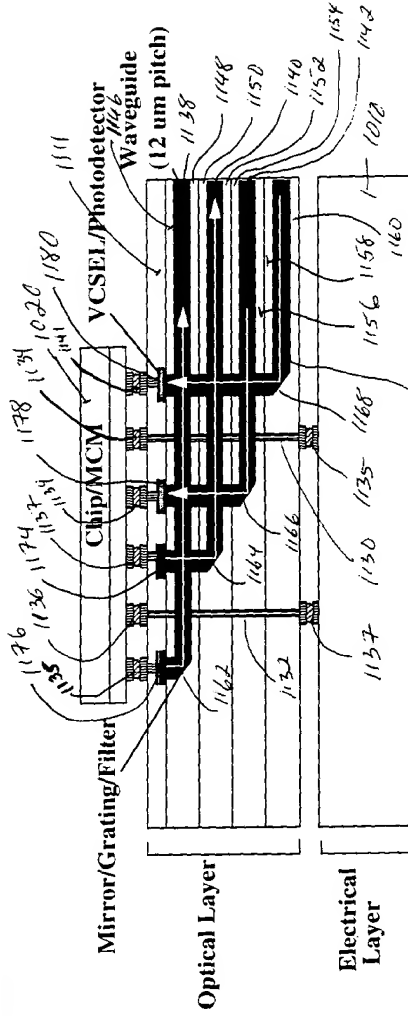


Fig. 189

FUJITSU Computer Packaging Technologies, Inc. **FCPT**  
**I/O Connection in OE Substrate (Active OE Layer)**

Signal I/O count: 6000 = [1500 I/O per Layer] x [4-Layer]

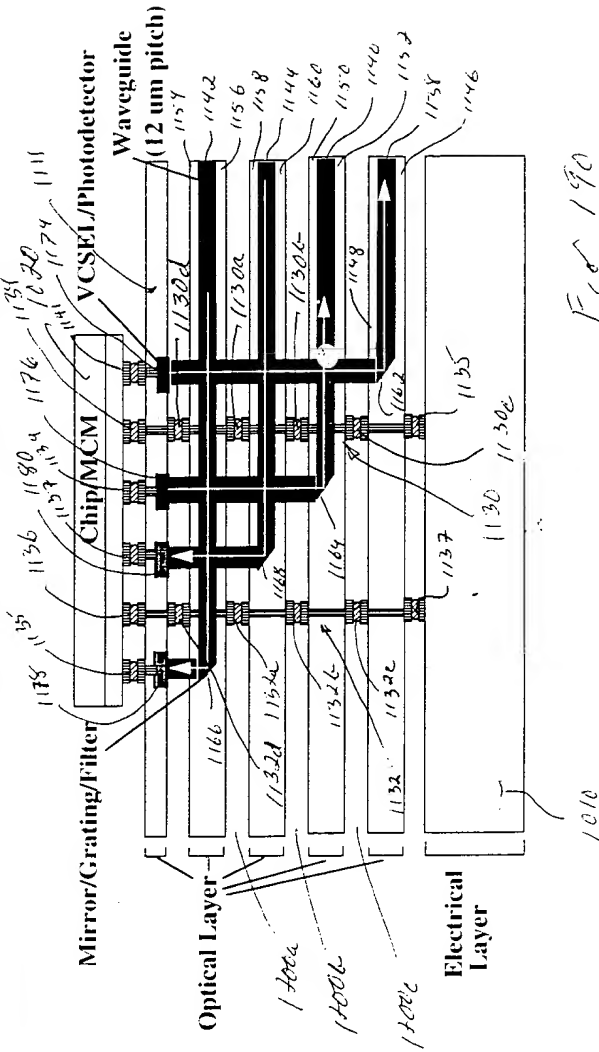
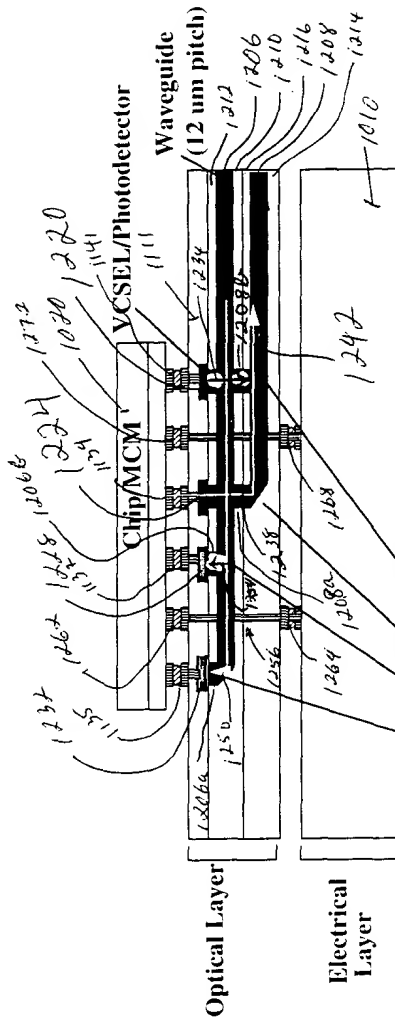


Fig 190

FUJITSU Computer Packaging Technologies, Inc. **FCPT**  
**I/O Connection in OE Substrate (Active OE Layer, WDM)**

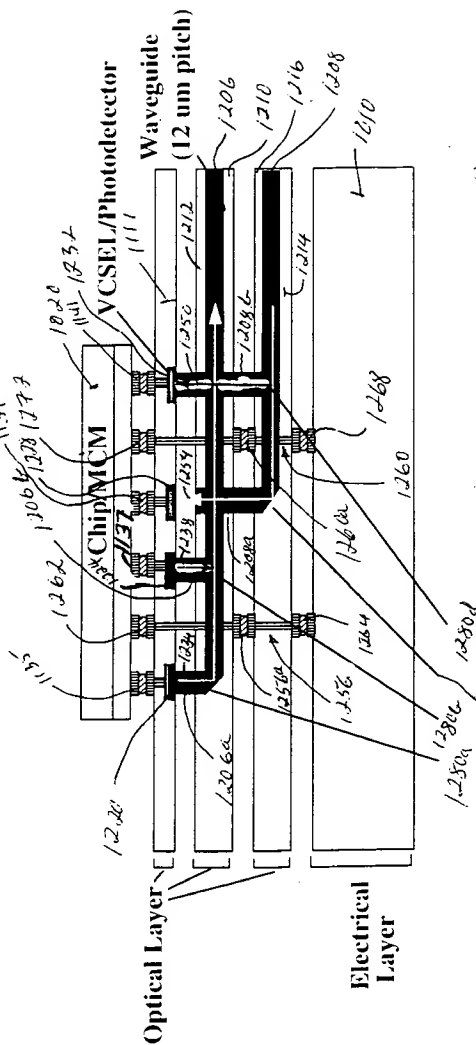
Signal I/O count: 6000 = [1500 I/O per Layer] x [4-Layer]



Grating/Filter 1280d  
 1280e  
 1280f  
 1280g  
 1280h  
 1280i  
 1280j  
 1280k  
 1280l  
 1280m  
 1280n  
 1280o  
 1280p  
 1280q  
 1280r  
 1280s  
 1280t  
 1280u  
 1280v  
 1280w  
 1280x  
 1280y  
 1280z  
 1280aa  
 1280ab  
 1280ac  
 1280ad  
 1280ae  
 1280af  
 1280ag  
 1280ah  
 1280ai  
 1280aj  
 1280ak  
 1280al  
 1280am  
 1280an  
 1280ao  
 1280ap  
 1280aq  
 1280ar  
 1280as  
 1280at  
 1280au  
 1280av  
 1280aw  
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 1280ay  
 1280az  
 1280ba  
 1280bb  
 1280bc  
 1280bd  
 1280be  
 1280bf  
 1280bg  
 1280bh  
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 1280bv  
 1280bw  
 1280bx  
 1280by  
 1280bz  
 1280ca  
 1280cb  
 1280cc  
 1280cd  
 1280ce  
 1280cf  
 1280cg  
 1280ch  
 1280ci  
 1280cj  
 1280ck  
 1280cl  
 1280cm  
 1280cn  
 1280co  
 1280cp  
 1280cq  
 1280cr  
 1280cs  
 1280ct  
 1280cu  
 1280cv  
 1280cw  
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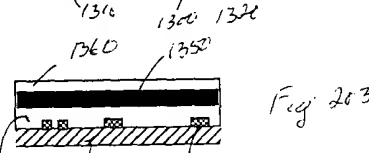
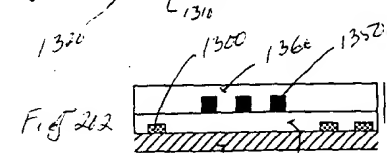
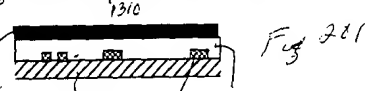
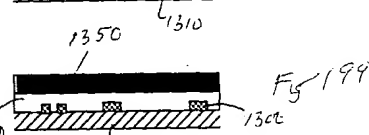
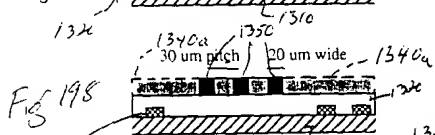
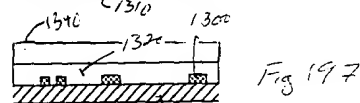
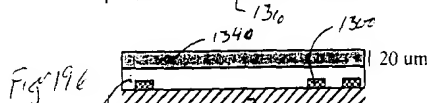
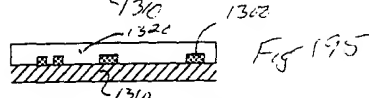
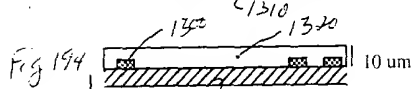
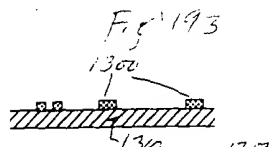
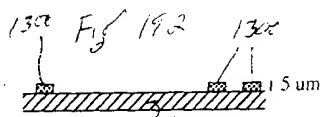
**FUJITSU** Computer Packaging Technologies, Inc. **FCPT**  
**I/O Connection in OE Substrate (Active OE Layer, WDM)**

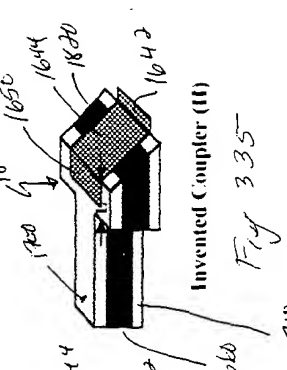
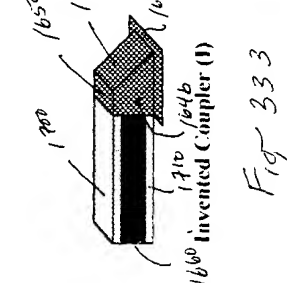
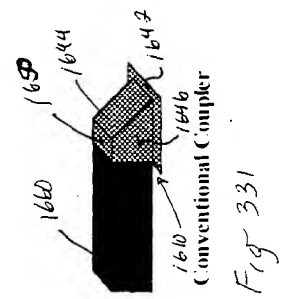
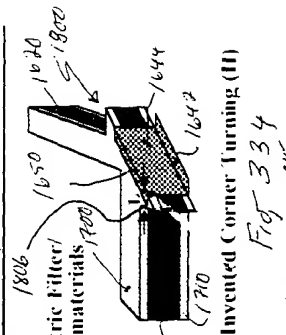
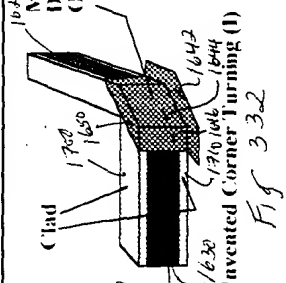
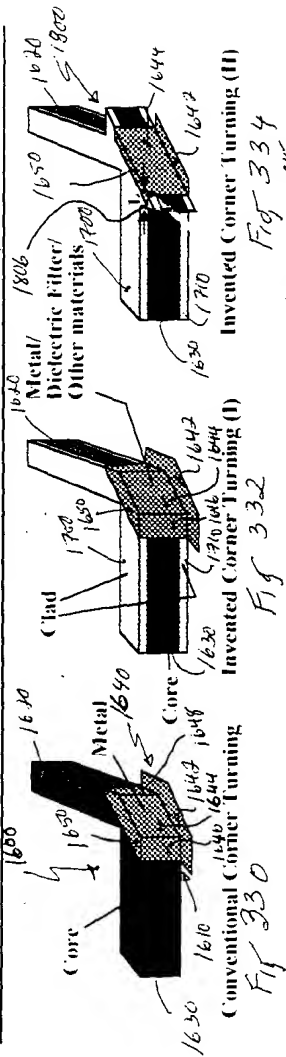
**Signal I/O count: 6000 = [1500 I/O per Layer] x [4-Layer]**



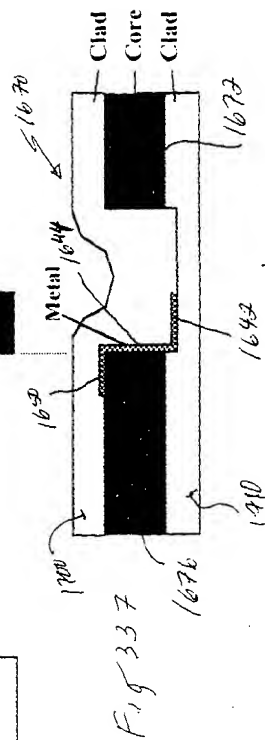
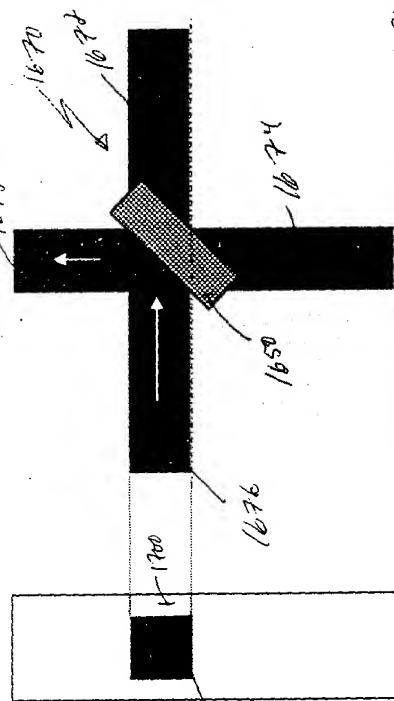
File 191B

## Grating/Filter





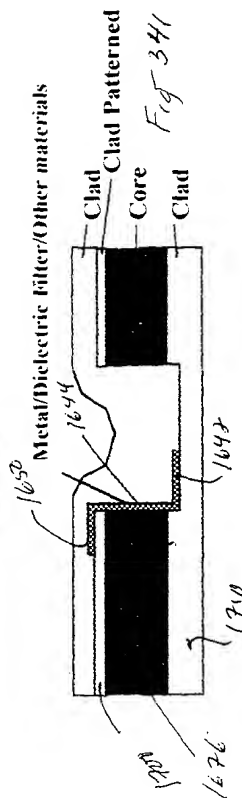
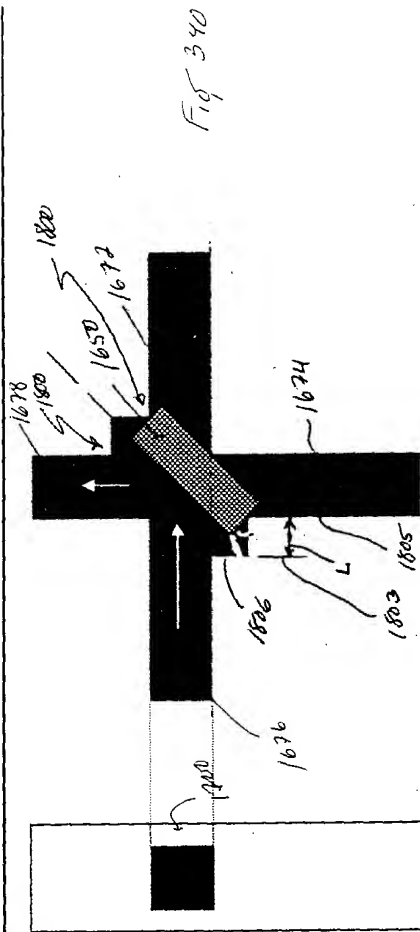
## Conventional Corner Turning Structure



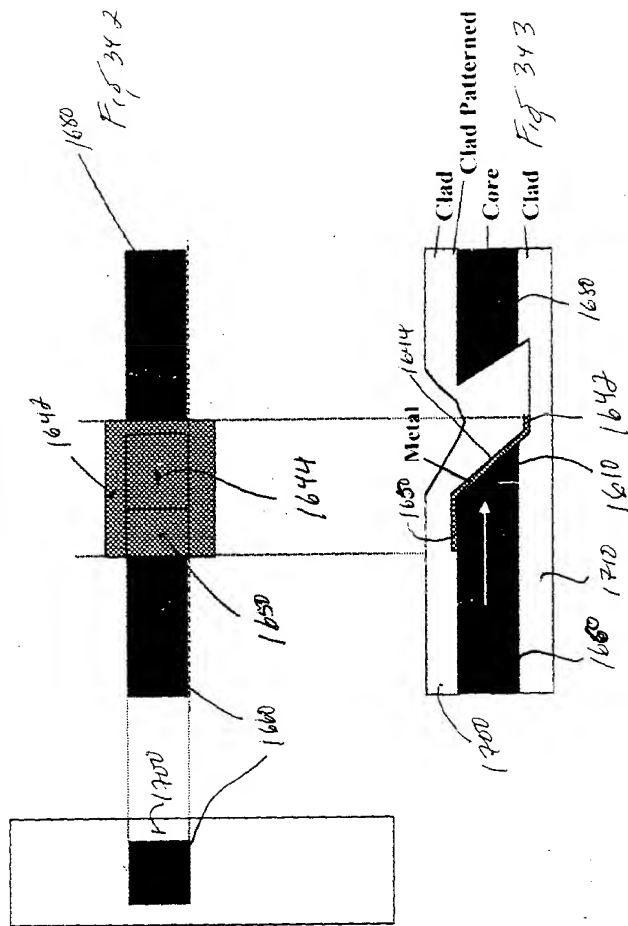


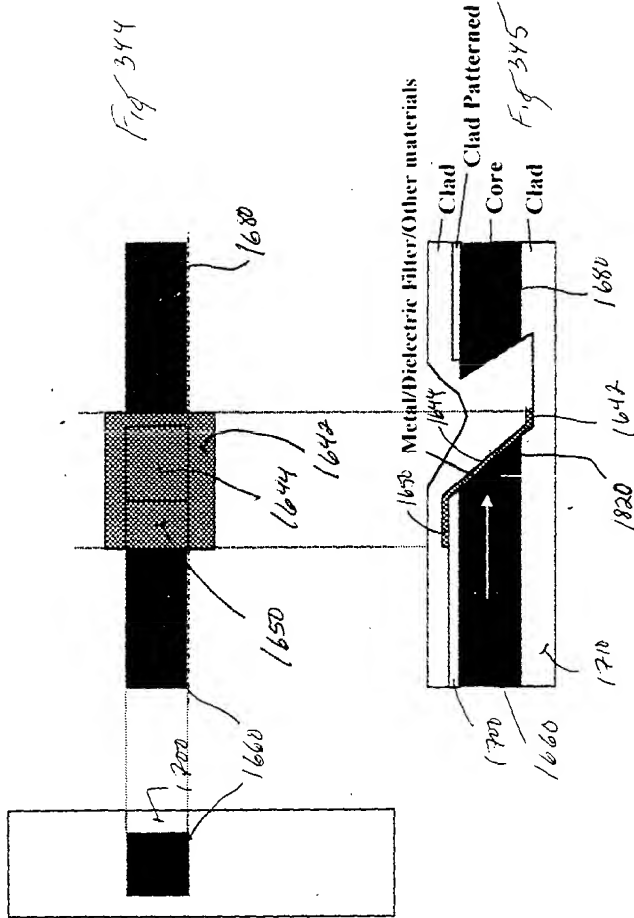


## Invented Corner Turning Structure (II)



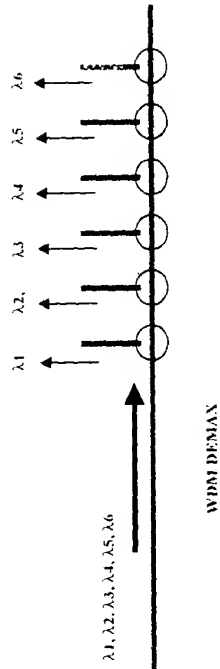
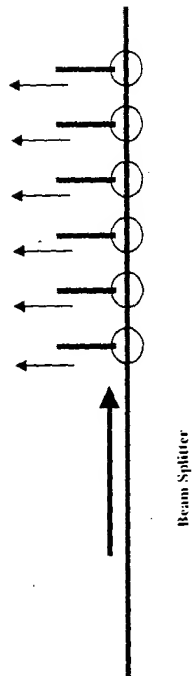
# Conventional Coupler Structure (I)



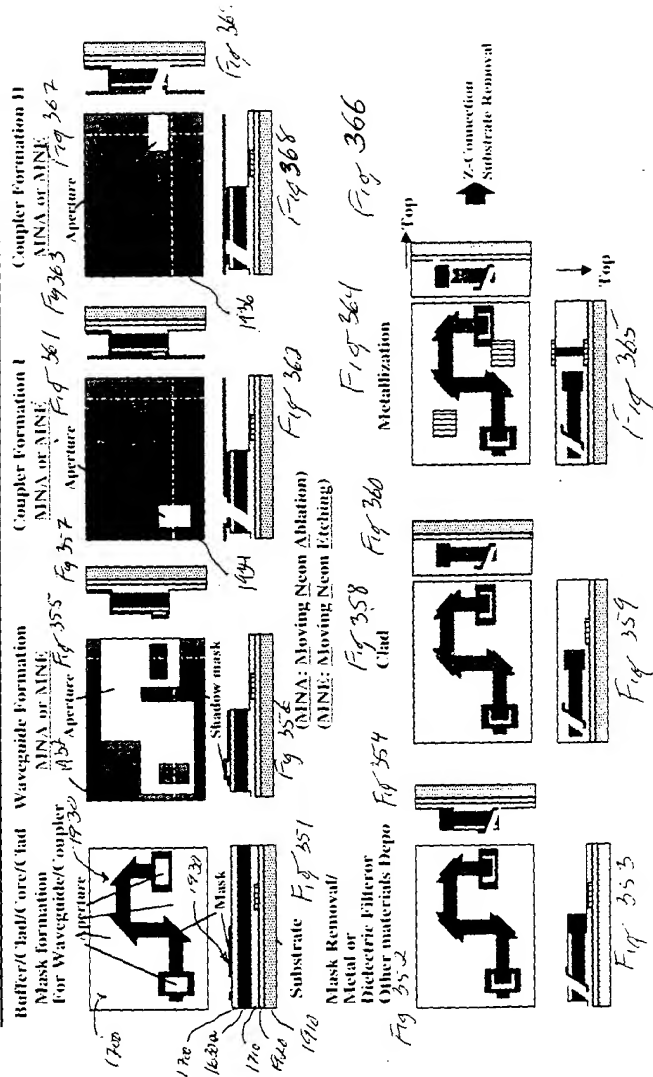




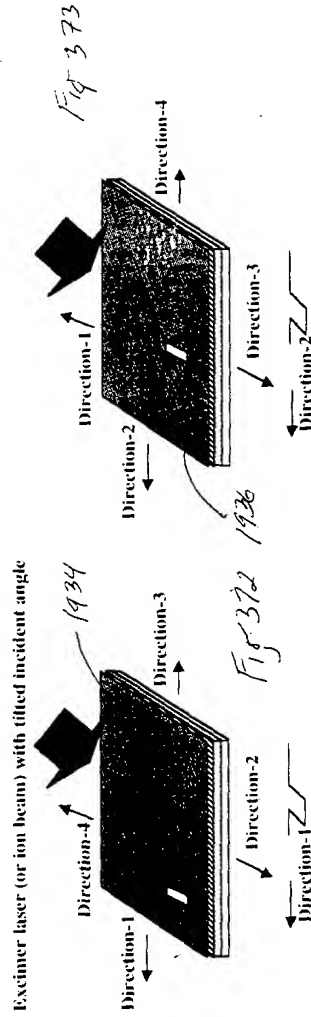
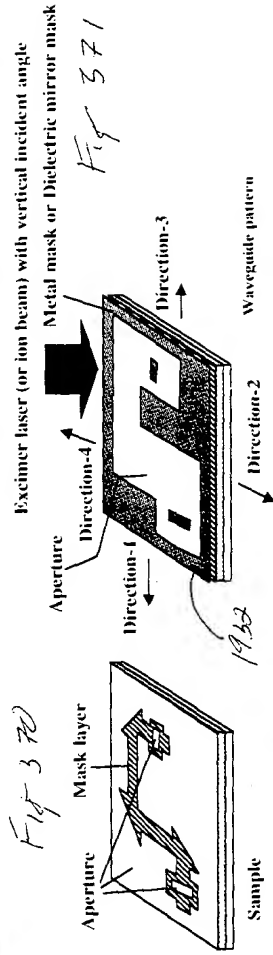
Excimer Laser Ablation Example for Beveled Cut (2)

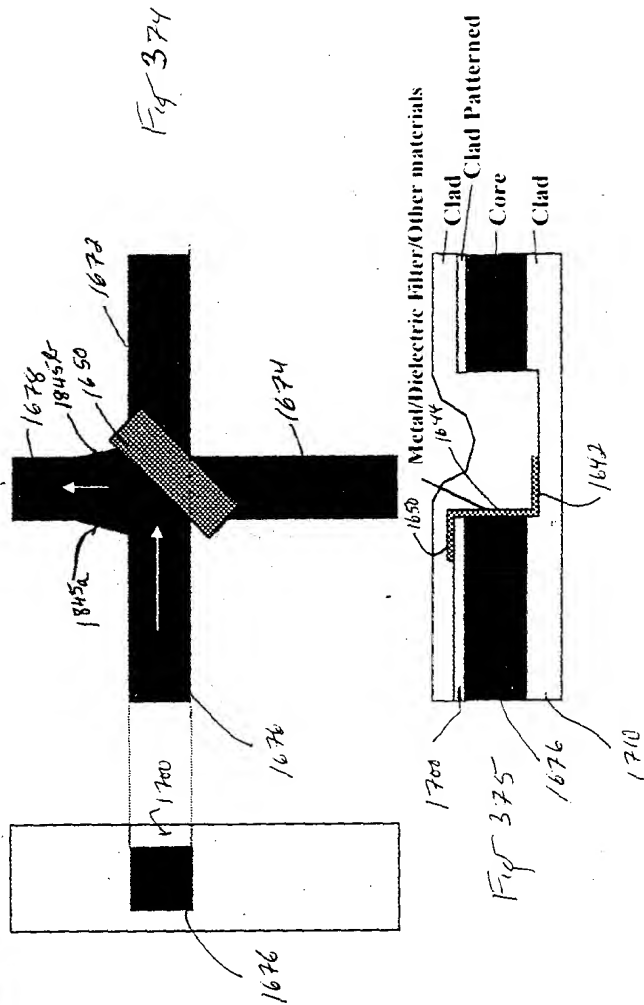


# Another Process Flow for Structure (II)



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**MNA, MNE Example for Add2 example**



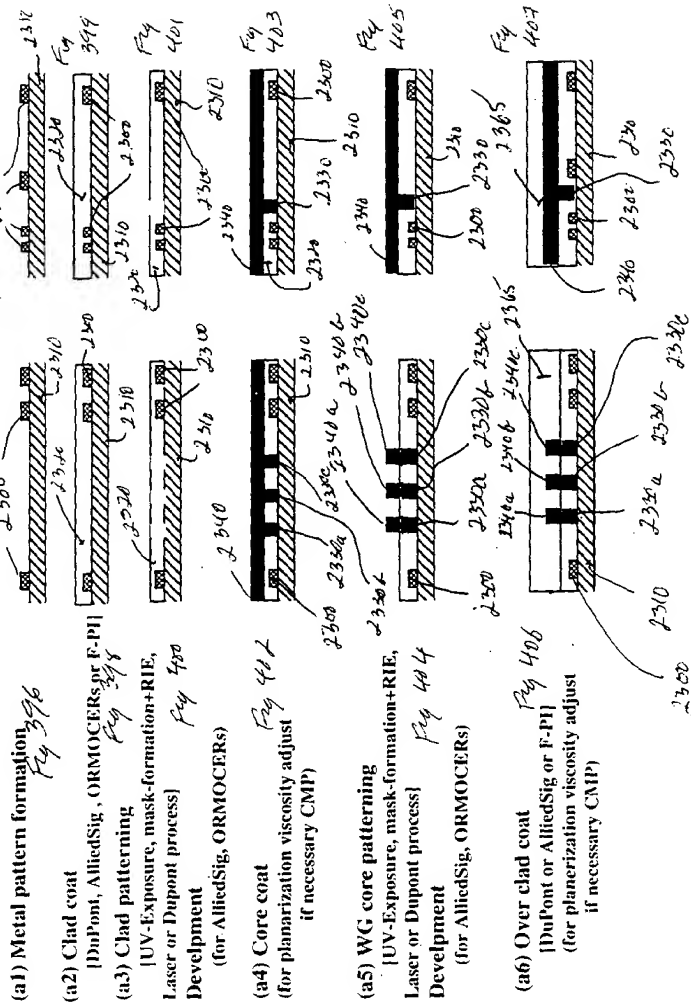




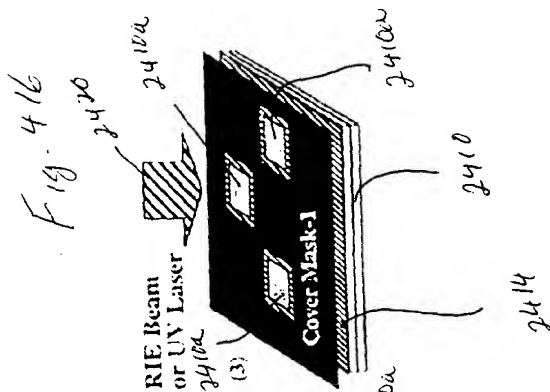
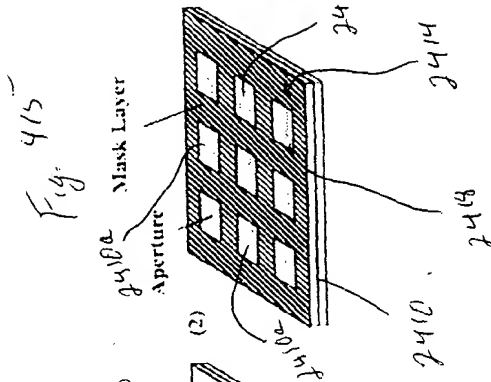
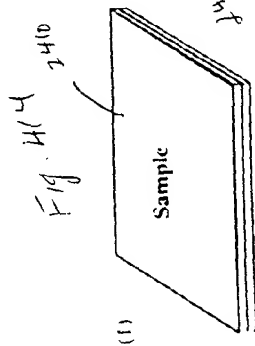
Feb 27 7

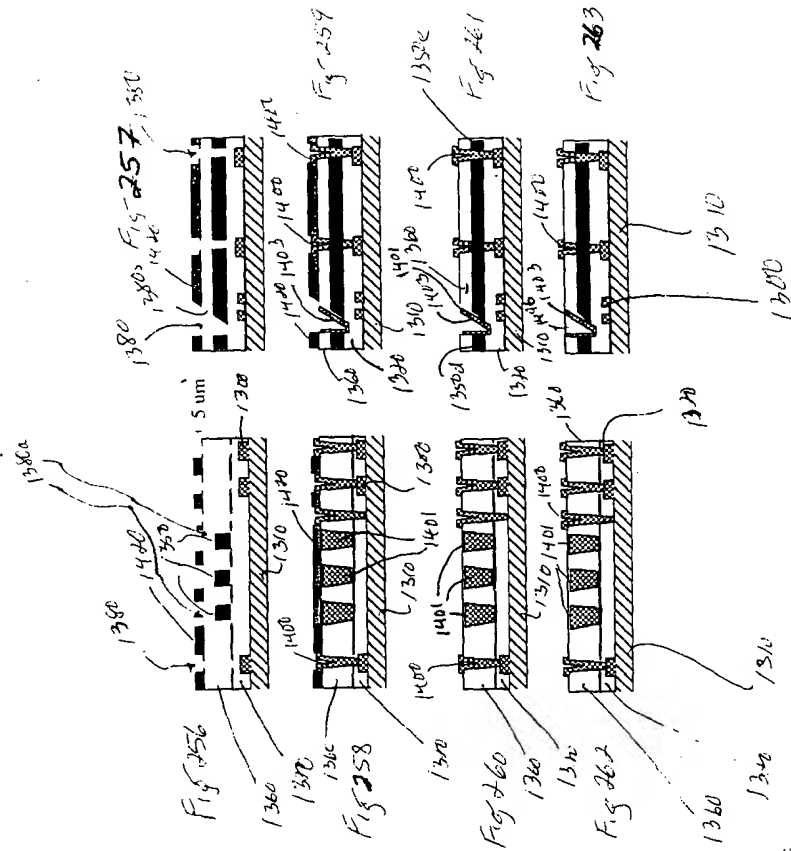


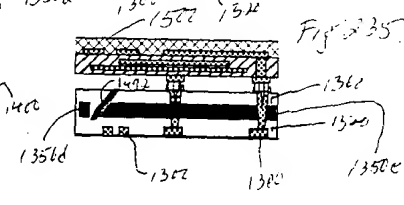
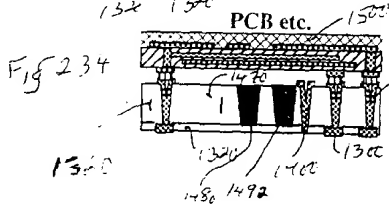
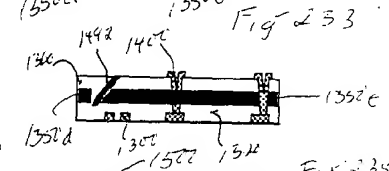
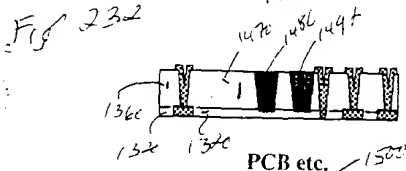
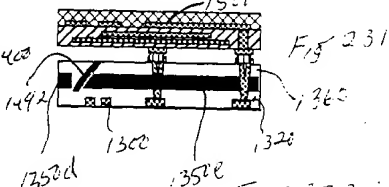
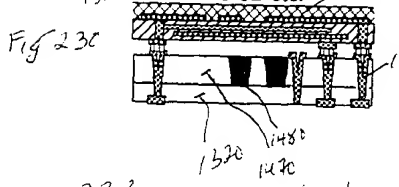
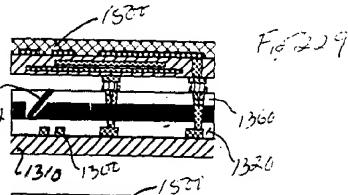
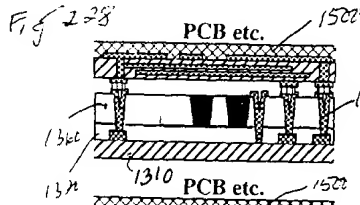
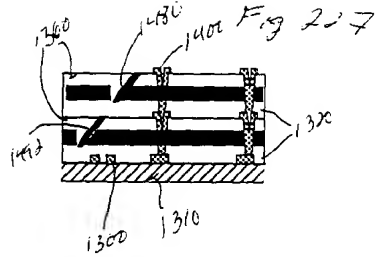
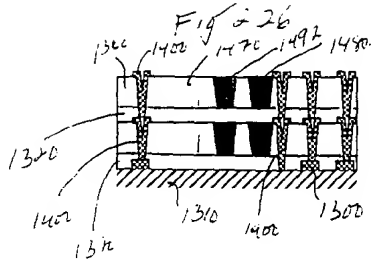
# Example 4: Z waveguide Fab. Process 2

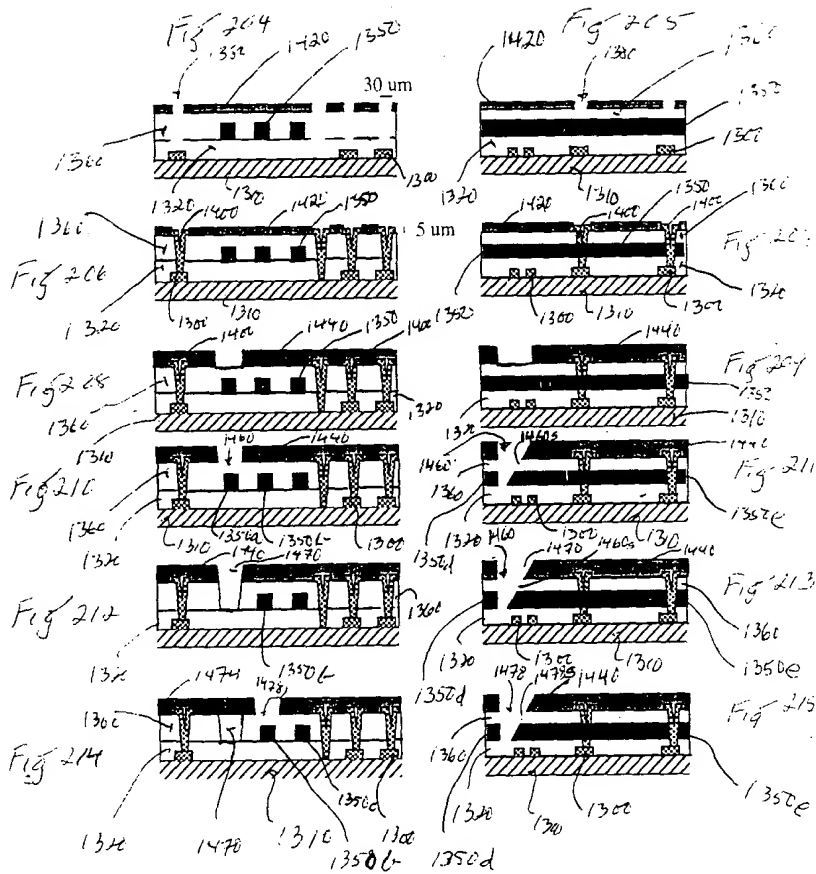


[illegible]

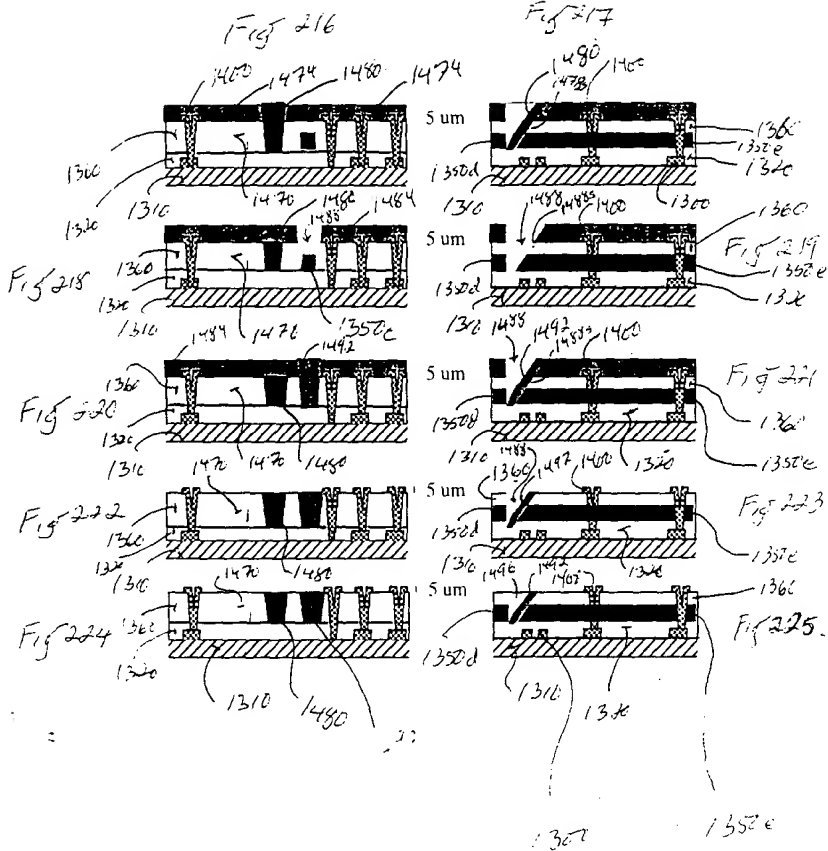


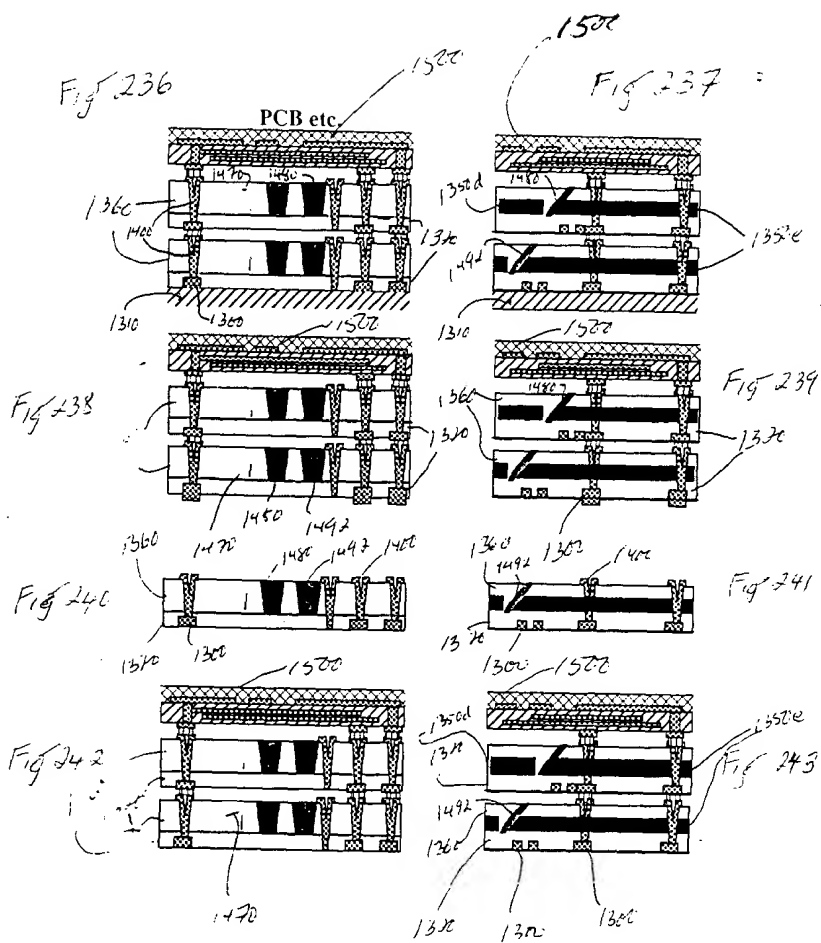












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Fig 244

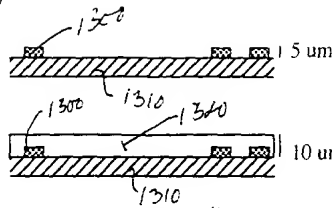


Fig 246

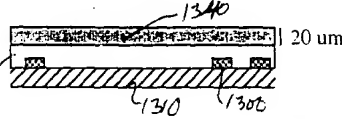


Fig 248

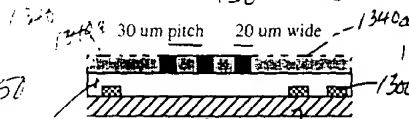


Fig 250

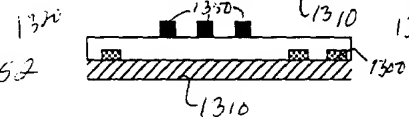


Fig 252

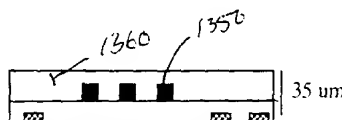


Fig 254

Fig 245

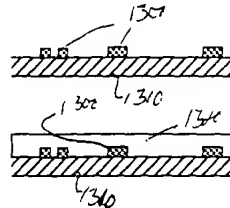


Fig 247

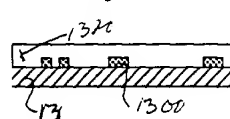


Fig 249

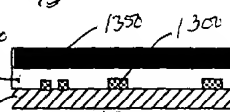


Fig 251

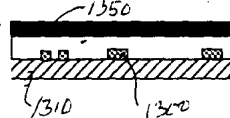


Fig 253

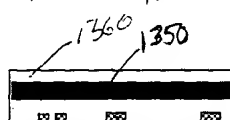
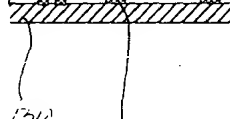
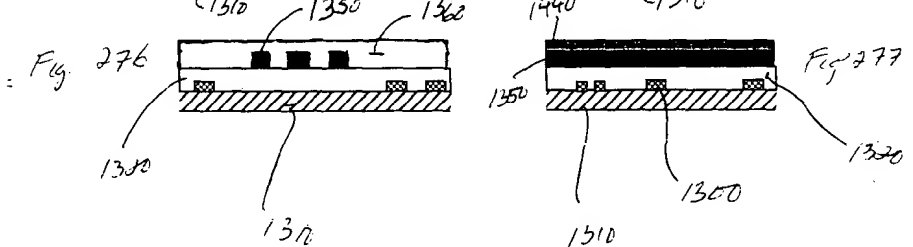
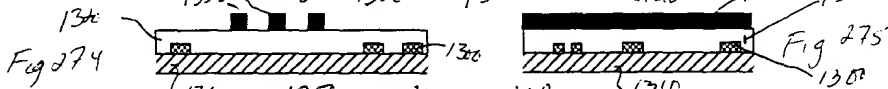
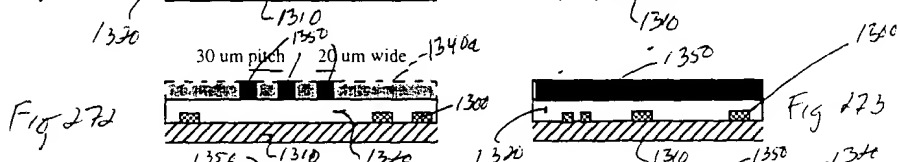
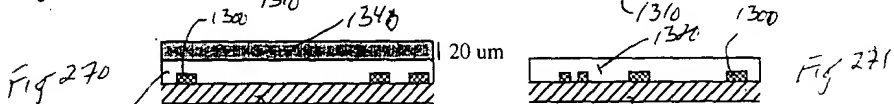
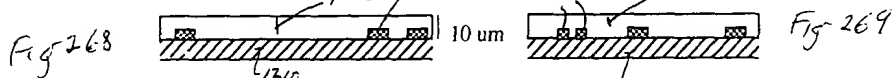
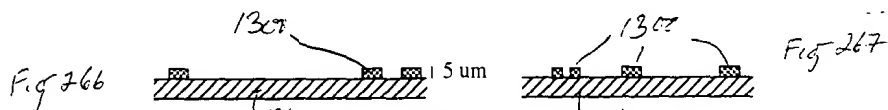
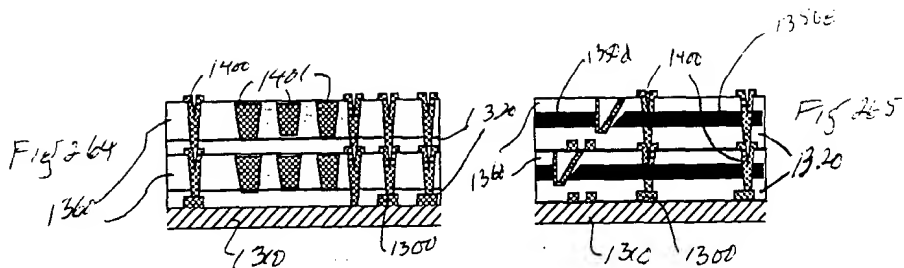
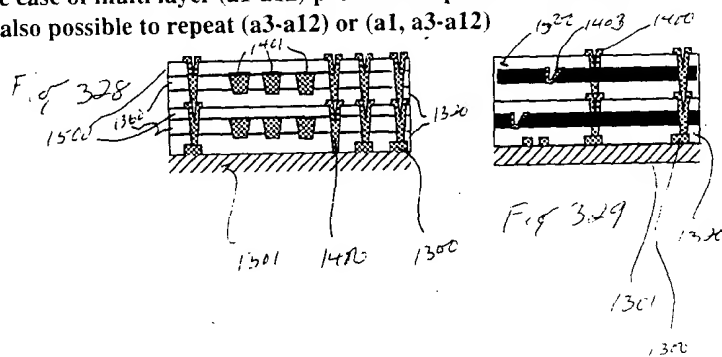
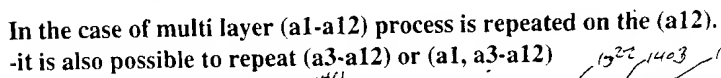


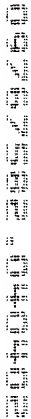
Fig 255

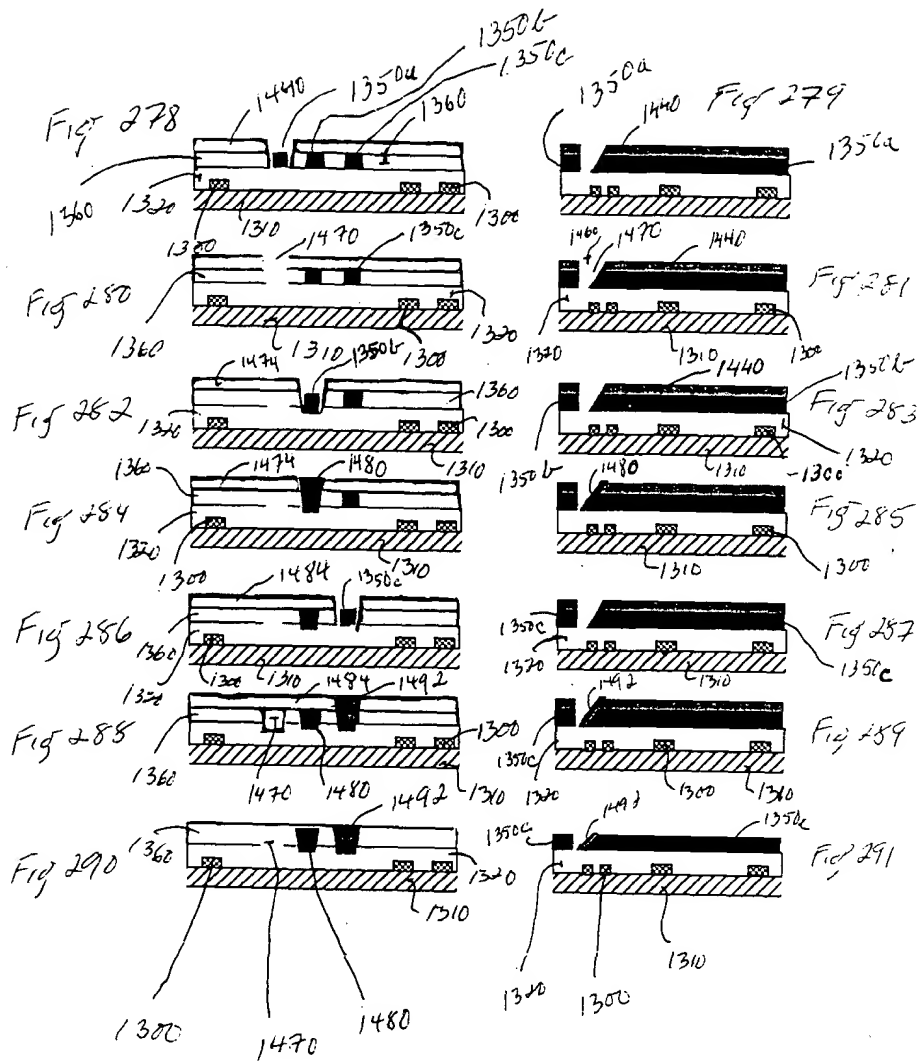




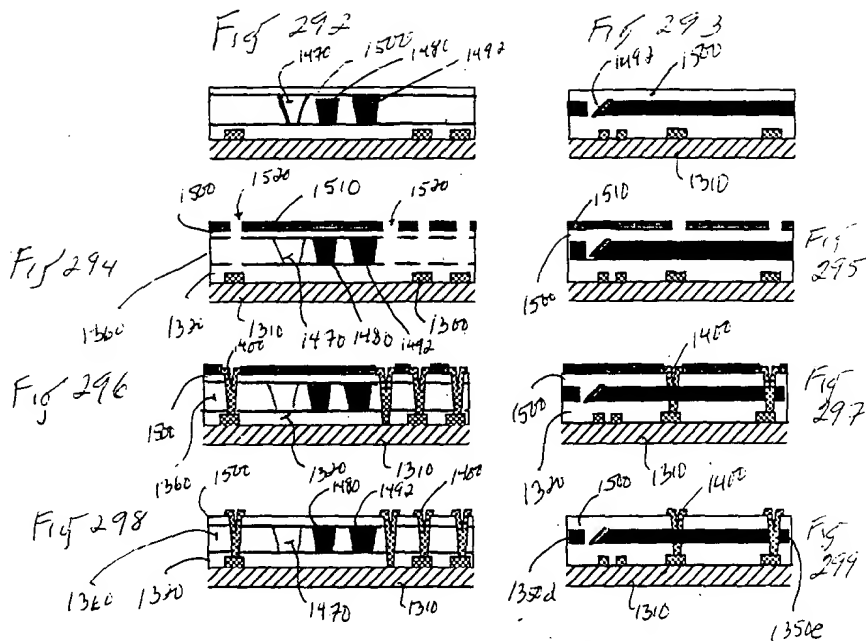




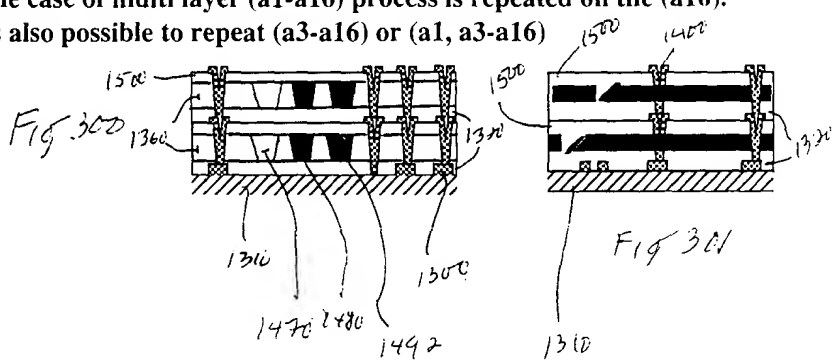








In the case of multi layer (a1-a16) process is repeated on the (a16).  
 -it is also possible to repeat (a3-a16) or (a1, a3-a16)



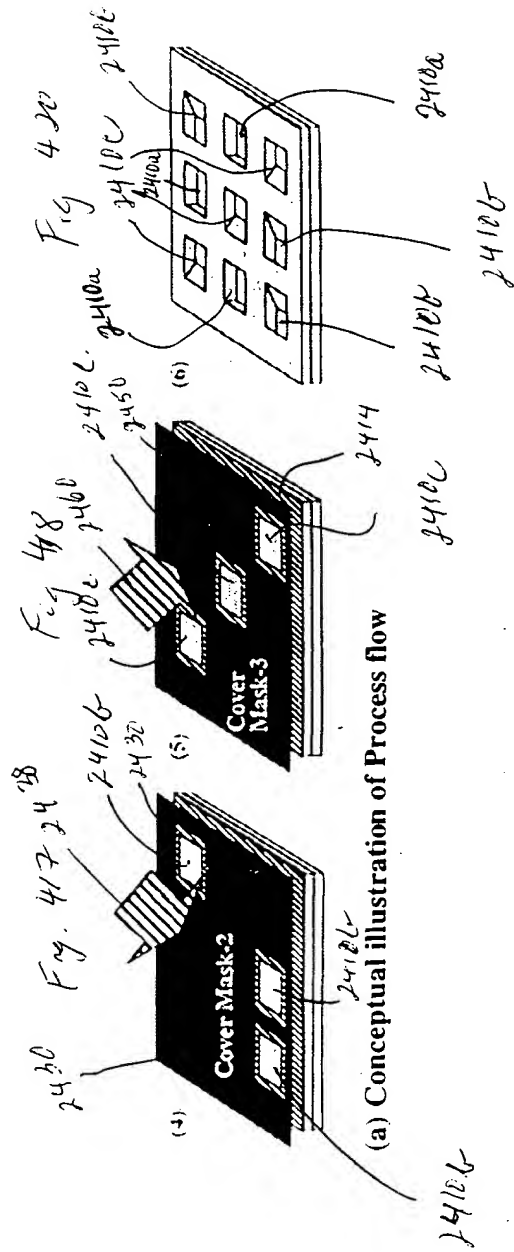
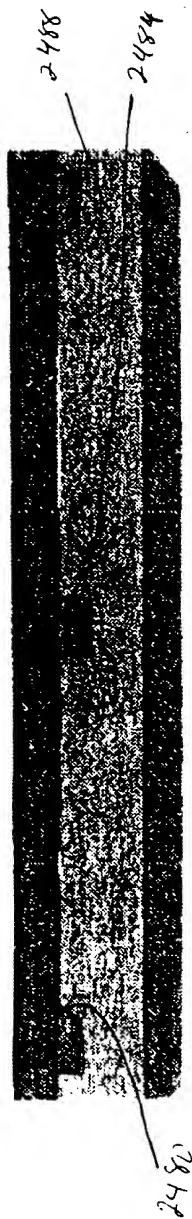


Fig. 4d1



250  $\mu\text{m}$

(b) Trench wall formation of three different angles